

HYDROGUARD HG-302

Swimming Pool Water Quality Analyzer and Controller

User Manual



2015

Document ID HG302TM1.2

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1. General Safety Precautions



This section presents important information intended to ensure safe and effective use of this product.

Read the following carefully before handling the product. These warnings and cautions must be followed carefully to avoid injury to yourself or damage to equipment.

Warning: Only properly trained and licensed electricians should attempt to wire or service the electronic components of the analyzer/controller.

Attention! Seuls des électriciens qualifiés ayant reçu la formation adéquate peuvent entreprendre le branchement, l'entretien ou la réparation des composants électroniques de l'analyseur/du contrôleur.

There is an Electrical Shock Hazard when servicing this system.

Il existe un risque de choc électrique lors de l'entretien de ce système.

Always verify that all electrical power source(s) are off before opening the analyzer/controller unit or attempting to service electronic components or wiring.

Ayez soin de toujours vérifier que la ou les source(s) d'alimentation électrique est ou sont bien déconnectée(s) avant d'ouvrir l'unité ou d'entreprendre toute opération de service technique et tout branchement des composants électroniques.

Caution: Extreme caution should be used when installing, operating, and maintaining the HYDROGUARD® Analyzer. Only properly trained technicians are authorized to install and maintain the analyzer/controller.

Attention! Il y a lieu d'agir avec une extrême prudence lors de l'installation, de la mise en œuvre et de la maintenance de l'HYDROGUARD®. Seuls des techniciens dûment formés à cet effet sont autorisés à effectuer l'installation et la maintenance de l'analyseur/du contrôleur.

Only properly trained and licensed swimming pool operators should attempt to make any changes to chemical dosing levels.

Seuls des opérateurs qualifiés de piscine dûment formés à cet effet sont habilités à modifier les dosages des produits chimiques utilisés.

Always follow local health and safety regulations when performing any service on the analyzer/controller unit or when changing chemical dosing settings.

Conformez-vous sans exception aux consignes locales de santé et de sécurité lorsque vous effectuez toute opération technique sur l'analyseur/le contrôleur, ou lorsque vous modifiez les paramètres de dosages chimiques.

The main power supply may be connected to either 110-120 or 220-240VAC 50/60Hz. Switching between voltages is accomplished by changing two (2) jumpers located above the main power connection, to the left of the transformer. For 110-120VAC, a 1amp fuse should be used; for 220-240VAC, a 0.5amp fuse should be used. These changes must be completed prior to wiring.

L'alimentation générale peut être branchée sur 110-120 ou sur 220-240VAC 50/60Hz. Pour basculer d'une tension à l'autre, il suffit de changer les deux (2) cavaliers situés au-dessus de la principale connexion électrique, à gauche du transformateur. Une tension à 110-120VAC requiert un fusible de 1 Amp. ; une tension à 220-240VAC requiert un fusible de 0,5 Amp. Ces modifications doivent être accomplies avant le branchement électrique.

Caution: Before connecting to a power source, confirm that both jumpers are located on the correct voltage and that the appropriate fuse is in place.

Attention! Avant de relier l'appareil à une quelconque alimentation électrique, vérifiez que les deux cavaliers sont situés sur les valeurs correctes de tension et que c'est le bon fusible qui est en place.

Remote control of pool water chemistry is potentially dangerous to bathers. The HYDROGUARD remote monitoring and control service is set by default to monitoring and reporting only.

Le contrôle à distance des dosages chimiques de l'eau de la piscine peut être dangereux pour les baigneurs. L'option de surveillance et de contrôle à distance de l'HYDROGUARD est paramétrée par défaut seulement pour la surveillance et l'émission de rapports.

Each relay connection is limited to 4 amps, to prevent overheating. The relays may show a higher rating but do not connect equipment exceeding 4 amps.

Chaque connexion relais est limitée à 4 Amp. afin d'éviter toute surchauffe. Même si les relais affichent éventuellement une valeur supérieure, ils ne se connecteront pas à un élément dépassant 4 Amp.

All electrical connections should comply with National Electrical Code (NEC) and all local regulations.

Mixing reagents:

Caution: Use protective gear as recommended in MSDS.

Caution: Do not use chemicals that reduce the surface tension. When using hydrochloric acid, observe all safety regulations.

Caution: HYDROGUARD's control board unit should not be opened except for initial installation and troubleshooting, and should only be opened by a trained and approved technician.

Tous les branchements électriques doivent être conformes au Code Electrique National (NEC – *National Electrical Code*) ainsi qu'à toutes les consignes locales.

Mélanges réactifs:

Attention! Utilisez l'équipement de protection préconisé dans la fiche de données de sécurité (MSDS).

Attention! N'utilisez pas de produits chimiques susceptibles de réduire la tension superficielle. Lors de l'utilisation d'acide chlorhydrique, appliquez scrupuleusement toutes les consignes pertinentes.

Attention! Le tableau de commandes de l'HYDROGUARD ne doit en aucun cas être ouvert si ce n'est lors de l'installation initiale et en cas de dépannage – auquel cas son ouverture ne doit être effectuée que par un technicien ayant reçu la formation adéquate et dûment habilité.

2. Preface

2.1. Intended Use

This manual is for qualified and trained pool service technicians who will install and service the HYDROGUARD HG-302 Water Quality Controller. It provides instructions on how to install the HYDROGUARD system, how to integrate it with external pool chemical dosing systems, as well as how to calibrate, operate, and maintain the system. This document includes some general information about how to monitor and maintain pool water quality, but it does not teach how to operate swimming pools or administer chemicals.

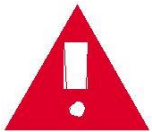
2.2. Safety Precautions

Warning:



Only properly trained and licensed electricians should attempt to wire or service the electronic components of the controller. There is an Electrical Shock Hazard when servicing this system. Always verify that all electrical power source(s) are off before opening the controller unit or attempting to service electronic components or wiring.

Caution:



Extreme caution should be used when installing, operating, and maintaining the HYDROGUARD HG-302 Water Quality Controller. Only properly trained technicians are authorized to install and maintain the controller. Only properly trained and licensed electricians should attempt any change to the system's electrical components. Only properly trained and licensed swimming pool operators should attempt to make any changes to chemical dosing levels. Always follow local health and safety regulations when performing any service on the HYDROGUARD unit or changing chemical dosing settings.

Note: During disassembly procedures, be sure to retain all hardware for use during disassembly. Upgrade and replacement kits may re-use some original components.

3. Overview of Chapters

This document is functionally divided into chapters and appendices according to the various steps involved in installing and operating the HYDROGUARD system.

Chapter 1:	Short Overview of manual layout and information
Manual Overview	
Chapter 2:	
Overview of Chapters	
Chapter 3:	General description of how water quality is maintained in swimming pools and how HYDROGUARD automatically monitors and controls
Controller Overview	
Chapter 4:	Instructs how to install HYDROGUARD and how to integrate it with pool water quality systems
Installation	
Chapter 5:	Instructs how to configure, calibrate, and operate the HYDROGUARD system immediately after it is installed
First Time Set-up	
Chapter 6:	Instructs how to respond to alarms and troubleshooting issues
Routine Operation & Maintenance	
Chapter 7:	Describes some popular optional components that may be installed on the controller or added at any time
Optional Features	
Chapter 8:	Lists and describes HYDROGUARD's operational components
Relays, Menus, Alarms, and Technical Data	
Chapter 9:	Describes how HYDROGUARD implements proportional monitoring and control and instructs how to configure it in various pool environments
Setting Proportional Control	
Chapter 10:	Provides a table for the technician to record parameter value settings in various pool environments
Recording settings	
Chapter 11:	A table of technical specifications for the HYDROGUARD HG-302
Technical Specifications	

4. Overview

The HYDROGUARD HG-302 Water Quality Controller continuously monitors and automatically controls chemical levels in pool water. HYDROGUARD automates chlorine, pH, ORP (Redox), temperature, and other water quality tests (i.e. turbidity, total chlorine, etc.), administering pool chemicals as required, according to the results of these tests.

4.1. Pool Chemistry Overview

Pool chemistry is the science of controlling the concentration of chemicals used to purify swimming pool water under changing conditions. Chlorine is commonly used to kill dangerous bacteria and other organisms that grow in pool water. Acid or base chemicals maintain proper pH values for the comfort of bathers and to effectively disinfect the water. These chemicals must be in a high enough concentrations to effectively kill water-borne bacteria. In overly high concentrations, however, these same chemicals may also be dangerous to swimmers who bathe in the pool. Various methods have been developed over the years to monitor and control the concentration and balance of chemicals used in pool water.

4.2. The HYDROGUARD Solution

The older manual methods of monitoring chemical balance are neither objective nor effective. HYDROGUARD measures free (and optionally total) chlorine levels with a digital photometer, which has many advantages over other types of sensors as well offering an option to present the combined chlorine. Digital photometer testing is completely objective. It is not dependent on lighting conditions or the operator's eyesight, and is far more accurate. It does not require frequent calibration and is compatible with all types of disinfectant systems. HYDROGUARD performs colorimetric testing in a closed reading cell. It is the only system that automatically and accurately measures free chlorine using small amounts of reagent.

Once installed and calibrated, HYDROGUARD is fully automatic. It controls dosing systems directly, releasing the proper quantity of chemicals based on frequent automatic measurements.

HYDROGUARD is simple to use. Its straight-forward control panel and parameters menu make chemical balance control an easy task. All basic information can be viewed at a glance, and changing settings is as simple as scrolling through the menu and adjusting the current settings.

4.3. Features and Modules

The HYDROGUARD unit measures four basic parameters that indicate pool water quality. Four optional modules may also be added. Details about the optional components are not included in this manual; Additional manual sections will accompany the optional features.

4.4. Standard Modules

- Free Chlorine
- pH
- ORP (Redox)
- Temperature

4.5. Optional Modules

- Total Chlorine
- Combined Chlorine
- Flow rate
- Turbidity
- Expert Pool – Wireless Management Package

4.5.1. Expert Pool

An advanced and unique HYDROGUARD option is the cellular communication package known as Expert Pool. Expert Pool provides web-based monitoring and control service of up to five controllers. The cellular communicator accepts HYDROGUARD's alarms and readings and transmits them to a web-based application server. The server then sends these readings and alerts via SMS (cellular Short Message Service), email, or Internet Instant Messaging to pool managers, inspectors, service technicians, and other authorized pool maintenance personnel. The communications between HYDROGUARD and pool maintenance personnel is bidirectional, allowing settings and features to be managed remotely through the Internet or from a mobile telephone.

Caution:



Remote control of pool water chemistry is potentially dangerous to bathers. The HYDROGUARD remote monitoring and control service is set by default to monitoring and reporting only. Remote control is available only upon special request.

4.6. System Components

HYDROGUARD has two primary units: the analyzing unit and the control unit. The analyzing unit performs the actual measurements. It contains the following components:

Colorimetric Reading Cell - measures free (and optionally total) chlorine levels in the water using DPD reagents and a closed-cell, digital photometer.

Flow Cell - contains the sensors, including the pH, Redox (ORP), and temperature sensors.

Reagent Bottles – contains the reagents used by the colorimeter to measure chlorine levels in the water.

Automatic Pumps and Solenoid Valve - accurately controls the flow of water and reagents into the colorimeter, making every measurement as accurate as possible.

The control units include all electronics and software that control the measurements performed in the analyzing unit and the chemical dosing by external dosing systems. It includes the following

components:

Control Panel - calculates the measurement results and determines the required chemical dosing to maintain an appropriate chemical balance, and provides data to external devices such as Expert Pool remote system.

Colorimeter Module - controls the colorimeter and associated components, such as the reagent pumps and solenoid valve. It calculates the accurate chlorine level.

Tube Sensor Module – receives the signal from the pH, Redox, and temperature probes.

Keyboard Panel - mounted on the cover of the control module, it functions as HYDROGUARD's user interface. The control panel displays current measurements and indicates alarms. All settings and adjustments are performed through the control panel.

I/O Module (Input/Output) – Power Supply to the controller and relays. The module contains the relays that control external dosing systems.

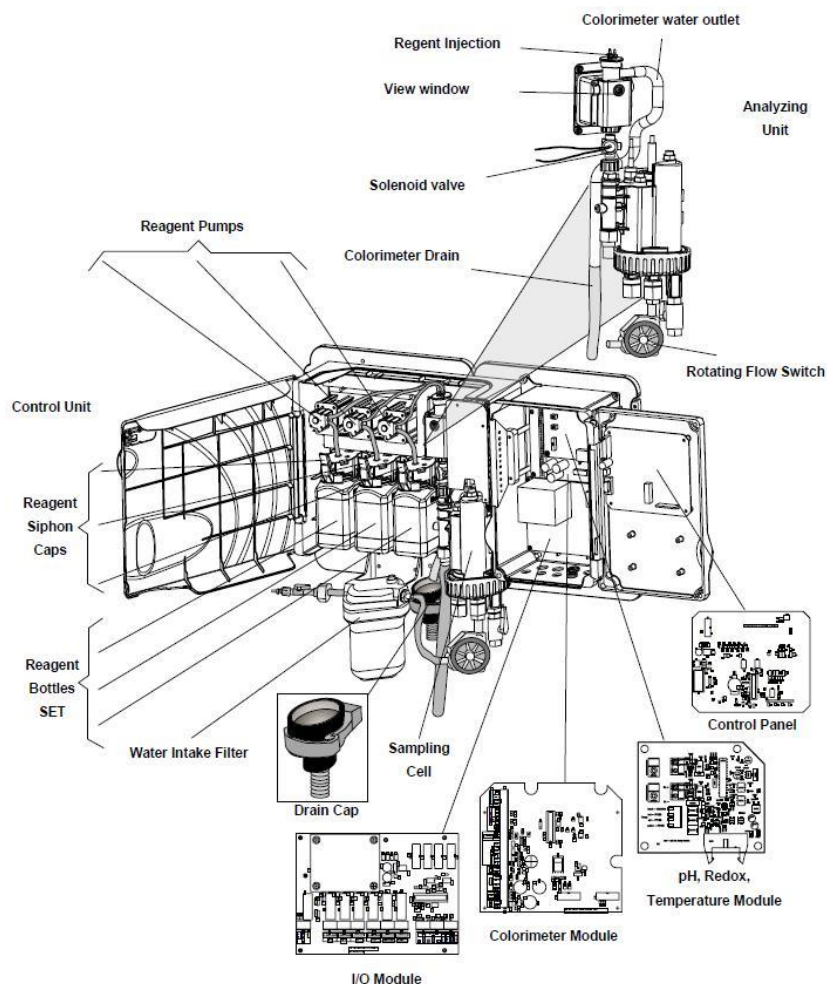


Figure 1: HYDROGUARD Components

5. Installation

Pump room installation involves several consecutive steps. The installation process starts with the manual installation and connection of the unit to the system that it controls, as described in this chapter. Once physically installed, sensors and reagents must be inserted into the unit and the control system must be started and calibrated, as described in Chapter 5, First Time Operation and Calibration. HYDROGUARD should operate for several days in order to be properly tuned to its specific pool environment. Additional periodic tuning, calibration, and maintenance are required after HYDROGUARD has been operating on a regular basis. This is described in Chapter 5, Continuous Operation and Maintenance.

5.1. Working Environment

Pollution Degree: 2

Installation Category: 2

Altitude: 2,000 m

Humidity: 1 to 90% non-condensing

Electrical Supply: 100-115Vac, 1.0A or 200-230Vac, 0.5A, 50/60Hz

Temperature: 5°C to 45°C

5.2. Selecting a Location

Take extra time in selecting a location since the installation location will determine the ease of the installation and future operation and maintenance. The location where HYDROGUARD is installed is dependent on various considerations:

Convenient Access - HYDROGUARD should be installed where it can easily be viewed and operated by pool personnel.

Dry Area – HYDROGUARD handles electricity and includes electronic circuitry that is susceptible to short-circuiting and/or corrosion when exposed to water or high ambient moisture levels.

Pool Chemicals - Pool chemicals can be corrosive to HYDROGUARD's electronic circuitry. It is highly recommended that HYDROGUARD is not installed adjacent to the pool chemicals storage area or the dosing systems themselves.

Minimum Distance from Pump - The water sampling line that is tapped into the main circulation pipe feeding HYDROGUARD should be as short as possible. A long sample line from the main circulation pipe to HYDROGUARD creates an unnecessary delay between supply, measurement, analysis, and chemical dosing.

Drainage – The location should easily allow the outlet of the colorimeter to gravity drain without creating an obstacle (i.e. pipe across walkway). The flow cell may be pressurized to allow for return to the system under pressure.

5.3. Recommended Installation Configuration

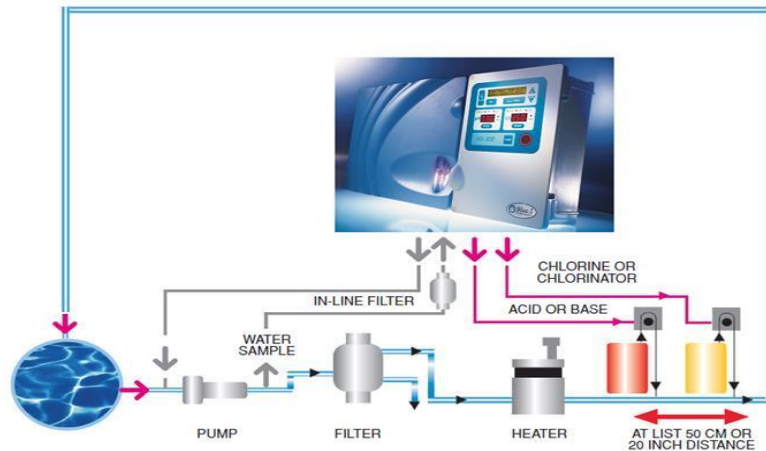


Figure 2: Recommended Installation Configuration

5.4. Site Requirements and Installation

The HYDROGUARD assembly is wall mounted. It should be located on a wall where pool operators and service technicians can easily access it for normal operation and maintenance. It is also advisable to install it where the pool operator can easily view the readings and alarms. Finally, the complete unit with all connections weighs 18 lbs. (8 kg), so it must be mounted securely onto a stable wall. The HYDROGUARD unit measures

26.3" x 13.1" (66.8 cm x 33.2 cm). The base of the complete HYDROGUARD assembly should be mounted at least 24" (60 cm) above the floor (preferably at eye level).

5.4.1. Mechanical Installation Requirements

The HYDROGUARD unit and its mounting panel are not shipped with mounting screws or anchors. The installer must provide screws and anchors that can hold the weight of the HYDROGUARD unit, mounting panel, intake filter, and electrical outlets and junction boxes. The screws and anchors must be compatible with the wall where it will be installed.

5.4.2. Mechanical Installation

The following procedure instructs how to install the HYDROGUARD unit in a pool pump room.

1. HYDROGUARD is shipped pre-mounted on a mounting panel, along with a water filter. The mounting panel includes four screw holes, one in each corner (A, B, C and D).
2. Determine the location of one hole (A) on the HYDROGUARD unit or on the mounting panel.
3. Mark the location of the screw hole and drill a hole for a screw anchor.
4. Screw one corner of the HYDROGUARD unit or mounting panel to the wall.
5. Level the HYDROGUARD unit or mounting panel and mark the remaining three (B, C and D)

screw holes.

6. Drill the three (3) remaining holes, insert anchors, and screw the remaining corners to the wall using 5/16" (8 mm) screws.



Figure 3: Mounting HYDROGUARD on the Wall

Note: HG 302 must be leveled in order to achieve proper operation.

5.5. Plumbing Requirements and Installation

5.5.1. Water Supply

HYDROGUARD requires a pressurized water supply to the flow cell, a zero pressure (gravity) water return from the colorimeter and a pressurized (or gravity) return from the flow cell. An isolating valve must be installed in the main circulation pump line, between the pump and the filter.



Figure 4: Water Filter

Water taken after the filter will have different chemistry than water taken before (specifically lower Cl levels). The pipe (or tube) from the main pipe should be as short as possible, in order to minimize the delay time between the pool water being sampled and HYDROGUARD testing the water and

adjusting dosing levels.

The water inlet (A) flow is 60-80lit/h, pressure 0.3-1 bar (4.4-14.5psi) should not exceed 1 bar (14.5 psi). The outlet (B) pressure will range accordingly 0-0.9bar (0-13psi). If your water inlet pressure exceed 1 bar (14.5 psi) a pressure regulate (Fig 4) should be installed.

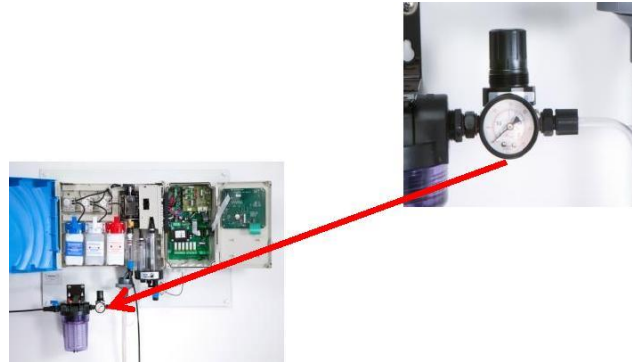


Figure 5: Pressure Regulator



Figure 6: Water Inlet and Outlet

5.5.2. Drainage

Two drainage connections are required. A gravity drainage connection is required for the water coming from the colorimeter. A pressurized, vacuum, or gravity connection is required from the outlet of the flow cell. The length of the colorimeter drain line should be as short as possible and must have a constant downward slope to prevent a backup of water. The flow cell may be pressurized up to 14.5 psi (1 bar); if the flow cell drain is connected to vacuum, the inlet pressure must be at least 7 psi (0.5 bar) greater than the drain vacuum. A drain cap is located on the colorimeter outlet to prevent the backup of water into the colorimeter if the drain line is blocked. A ½" NPT fitting is supplied for the colorimeter drain connection and a ¼" FNPT fitting is supplied for the flow cell drain connection



Figure 7: Colorimeter Drainage

Note: The HYDROGUARD colorimeter drains water at zero (0) pressure. The drainage pipe should be as straight as possible and have a constant downward slope and should not have any bends where water flow can be restricted. If the colorimeter drains to a bucket or basin, the end of the drainage pipe should terminate above the bucket or basin rim.

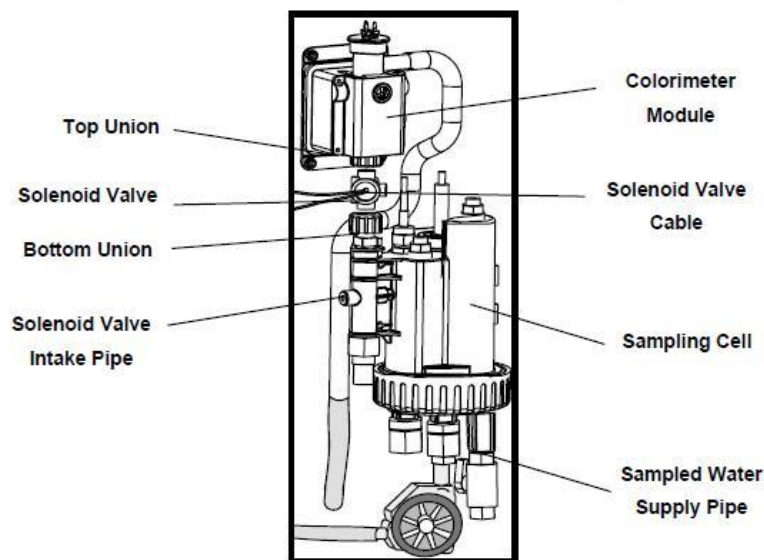


Figure 8: Flow Cell and Colorimeter Components

5.6. Electrical Requirements and Installation

HYDROGUARD requires a 110-120 or 220-240 VAC, 50/60 Hz electrical power source on a separate 16A circuit in the plant room's electrical board. The main HYDROGUARD power supply should be connected to a non- dependent power supply, so that the unit remains powered constantly. The active relays should be connected to a (pump) dependent power supply (interlocked power supply) to provide an additional layer of protection against chemical addition and equipment operation when the main circulation pump is not operating.

5.6.1. Connecting the Main Electrical Power Source

The Main Power Supply may be connected to either 110-120 or 220-240VAC 50/60Hz. Switching

between voltages is accomplished by changing two (2) jumpers located above the main power connection, to the left of the transformer. For 110-120VAC, a 1amp fuse should be use; for 220-240VAC, a 0.5amp fuse should be used. These changes must be completed prior to wiring.

Caution:



Before making a connection to a power source, confirm that both jumpers are located on the correct voltage and that the appropriate fuse is in place.

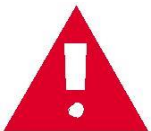
1. Verify that the power switch or circuit breaker to the non-dependent power source is off.
2. Connect the line (live) wire to the electronic relay board connector marked **Line**.
3. Connect the neutral wire to the electronic relay board connector marked **Neutral**.
4. Connect the earth wire to the I/O Module connector marked **Ground**.
5. Continue with the other electrical connections.
6. Turn on electrical power only **after** all electrical connections have been completed.

5.6.2. Connecting the Dependent Relay Power Source

The line (live) wire of the pump-dependent power source connects to the connection labeled **Common** on each relay. The line wire of each controlled system is connected to the normally open (N_O) or normally closed (N_C) connection of each relay as appropriate. Normally Open means that the relay will be open (i.e., no power from the relay) until the controller calls for power; Normally Closed means that the relay will be closed (i.e. power from the relay) until the controller calls to stop power.

1. Verify that the power switch or circuit breaker to the pump-dependent power source is off.
2. Connect the earth wire to the ground return wire from each of the controlled dosing systems.
3. Connect the neutral wire to the return wire from each of the controlled dosing systems.
4. Connect the line (live) wire to the connector marked **Common** of each active relay.

Caution:



Each relay connection is limited to 4 amps, to prevent overheating. The relays may show a higher rating but do not connect equipment exceeding 4 amps.

5.6.3. Input Switches

An input switch terminal block on the I/O module allows for three input switches to be connected to the system as additional layers of security against accidental chemical additions. If a connection is not detected at each input, the controller will not activate any equipment or dose any chemicals. Therefore, if a safety switch (flow, level, etc.) will not be installed, a fixed connection (jumper wire) is required to allow the controller to operate. The switch connections are:

Input Switch 1 (between input 1 and 2): open connection with factory installed jumper

Input Switch 2 (between input 3 and 4): connected to rotating flow switch, Figure 7, on the flow cell

Input Switch 3 (between input 5 and 6): external flow switch connection with factory-installed jumper

Caution:



An external flow switch is required between points 5 and 6 on the input switch terminal block. The controller will not feed any chemicals if this connection is not present, therefore, the controller has a jumper wire pre-installed to allow for initial set-up and testing; however Blue I Technologies does not recommend operating the controller with this jumper installed unless a flow meter is used in place of the flow switch.



Figure 9: Rotating Flow Switch



5.6.4. Wiring to Dosing Systems

HYDROGUARD controls chemical dosing systems using a series of electronic relays that start and stop the dosing pumps. Each relay opens and closes a switch that activates a separate pump or piece of equipment.

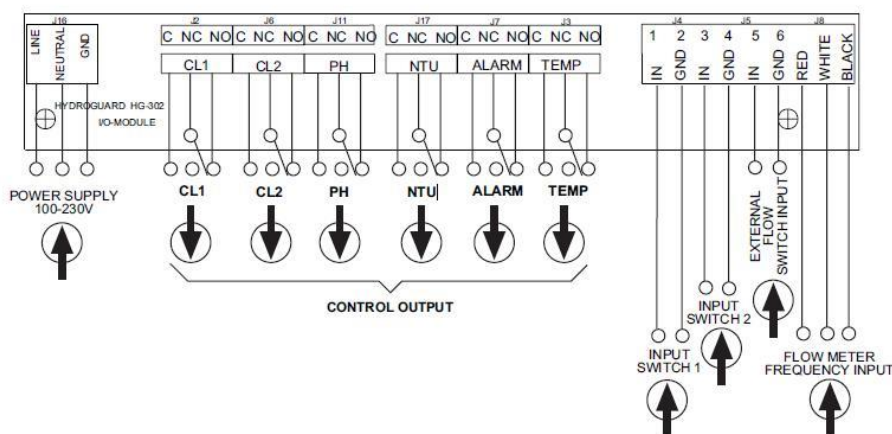
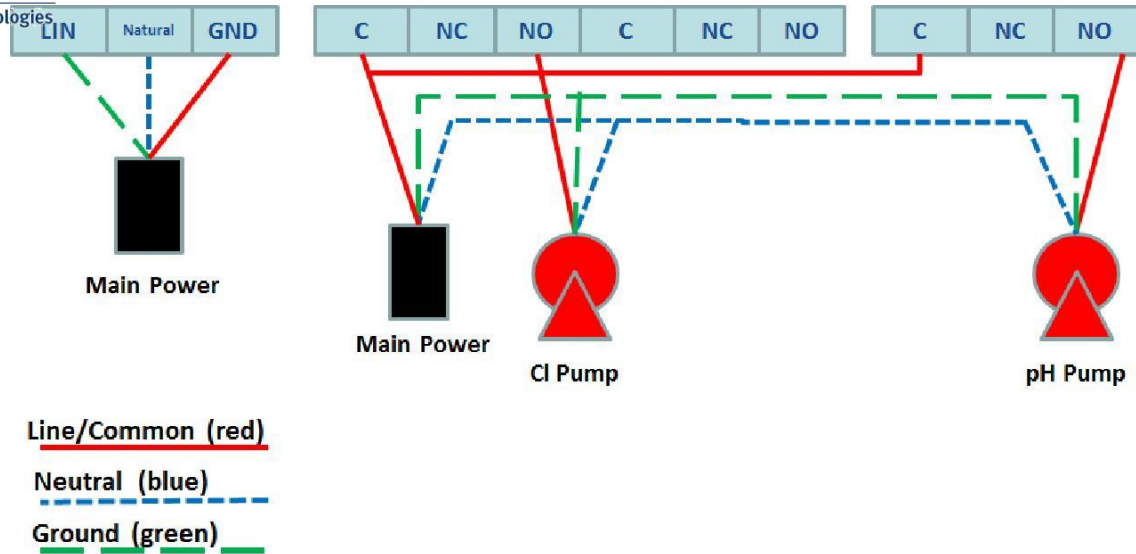
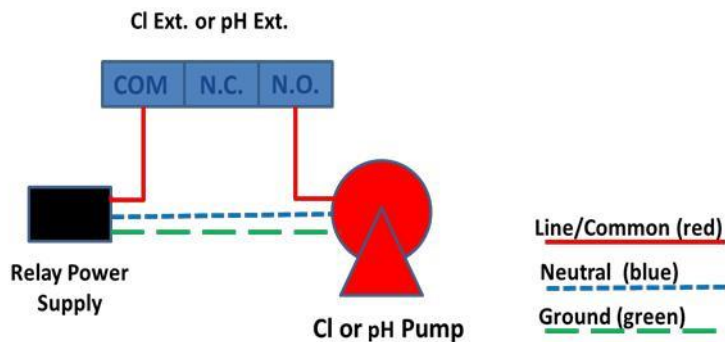


Figure 10: Schematic of I/O Board



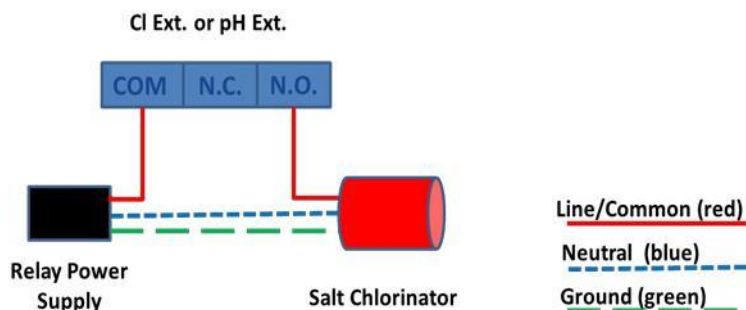
5.6.4.1. Dosing Pump or Solenoid Valve

1. Dosing will turn ON based on HG-302 decision to add chemicals.
2. Connect the Line (live) wire through COM and N.O.



5.6.4.2. Salt Chlorinator

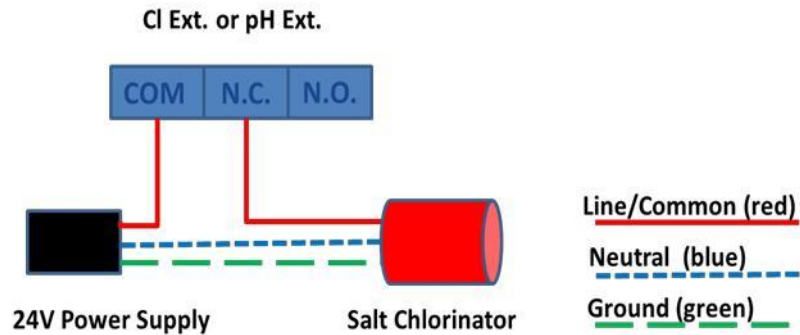
1. Dosing will turn ON based on HG 302 decision to add chemicals.
2. Connect the Line (live) wire through COM and N.O.



5.6.4.3. Salt Chlorinator (dry contact or 24V)

1. Dosing will turn ON based on HG 302 decision to add chemicals.

2. Connect 24V wire between COM and N.C.
3. The Chlorinator will receive 24V all the time. ("OFF" dosing time)
4. The voltage will disconnect from salt generation ("ON" dosing time) based on HG 302 decision to add chemicals.



5.6.5. Relays and the Dosing Systems They Control

Table 1: Relays and the Dosing Systems They Control

Relay	Control
CI 1	Main chlorine system On/Off or proportional. Proportional controls pulse length or pulse frequency
CI 2	Secondary chlorine system (On/Off only – no proportional control)
pH	Acid or base dosing On/Off or proportional. Proportional controls pulse length or pulse frequency
NTU	Nephelometric Turbidity Units – Controls the injection of flocculants or coagulants. Used only with the optional turbidity module.
Alarm	Activates an external alarm when certain alarm types are registered and after the alarm delay time has expired.
Temperature	Controls water temperature by activating the water heating system.

Caution:



Electrical connections in this section are ONLY recommendations. All electrical connections should comply with National Electrical code (NEC) and all local regulations.

6. First Time Operation and Calibration

6.1. Installing Sensors

The following procedure describes how to install the Redox (ORP) and pH sensors in the HYDROGUARD unit. The installation of all the sensors in the flow cell is similar, expect for the connecting wires.

Caution:



Make sure the pH and Redox sensors have plastic or rubber plugs covering their ends. Use another sensor if the plug of any sensor is missing or has fallen off.

Make sure to connect the appropriate wire to the appropriate sensors. Labels are located on the wires near the probe connection and on the connection on the tube probe Module.

1. Remove the sensor from its packing box.
2. Remove the plastic cover or plug from the end of the sensor and drain the solution from the tube. Keep the plastic cover in a safe place for winterizing or storage of probes.
3. Hold the sensor by its metal connector with the glass tube pointing down.
4. Insert the sensor into the top of the transparent flow cell and thread in securely. DO NOT OVERTIGHTEN.
5. Connect the appropriate sensor plug to the sensor's metal connector. Make sure the proper plug is connected to the correct sensor.
6. Switch the HYDROGUARD ON, verify that pH reading appears on the red LED display and the ORP (Redox) reading appears in the LCD display.

Observe the pH and ORP (Redox) levels and wait several minutes until both readings stabilize.

If either one or both indicators do not display a proper reading or are not stable, see Troubleshooting.

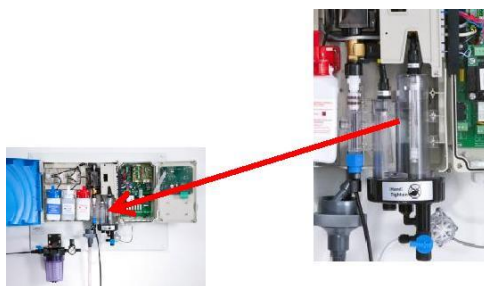


Figure 12: Installing Sensors in Sampling Cell

6.2. Installing Reagents

The following procedure describes how to mix and install the reagent bottles:

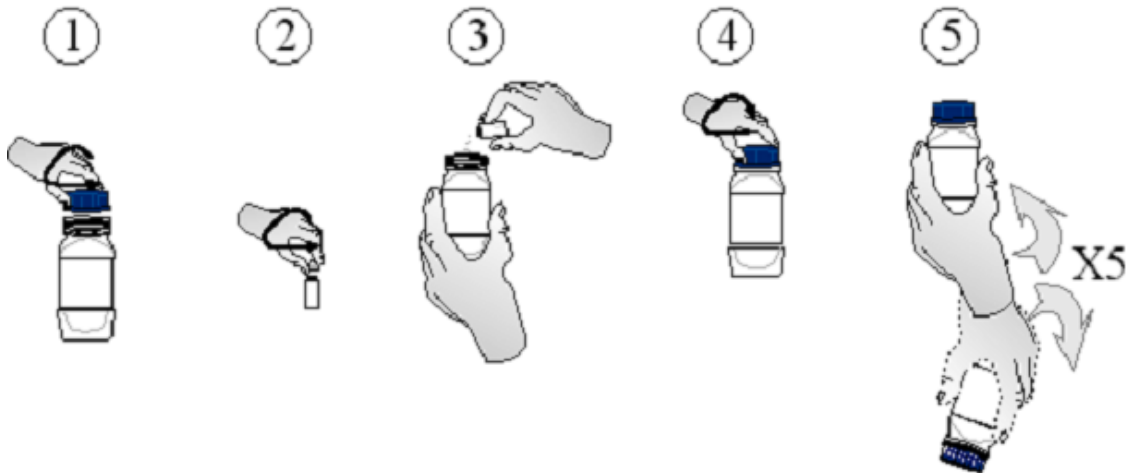


Figure 13: Mixing Indicator Salt into Indicator Fluid

1. Open the HYDROGUARD Chlorine Indicator and Buffer kit. The following items should be in the box:
 - A. Chlorine indicator and buffer mixing instructions.
 - B. 1 X 500 ml bottle of chlorine buffer with a **white** label.
 - C. 1 X 500 ml bottle of chlorine indicator fluid with a **blue** label.
 - D. 1 X small bottle of chlorine indicator salt with a **white** label.
2. Remove the caps on both the indicator fluid and small indicator salt bottles.
3. Empty the contents of the indicator salt into the bottle of indicator fluid.
4. Place the cap on the bottle of chlorine indicator fluid and close tightly.
5. Turn the bottle upside-down **slowly and carefully**, so that no bubbles form in the fluid.
6. Repeat five (5) times until all the indicator salt is dissolved in the indicator fluid.

Warning Use protective gear as recommended in MSDS.

7. Place the reagent bottles in position:
 - A. Remove the cap from the reagent bottles.
 - B. Place the opening of the reagent bottle below the bottle siphons.
 - C. Lift the bottle up until the opening reaches the bottle siphon cap.
 - D. Push the lever above the siphon cover away from you, and push the reagent bottle up.
 - E. Push the bottom of the bottle into position.

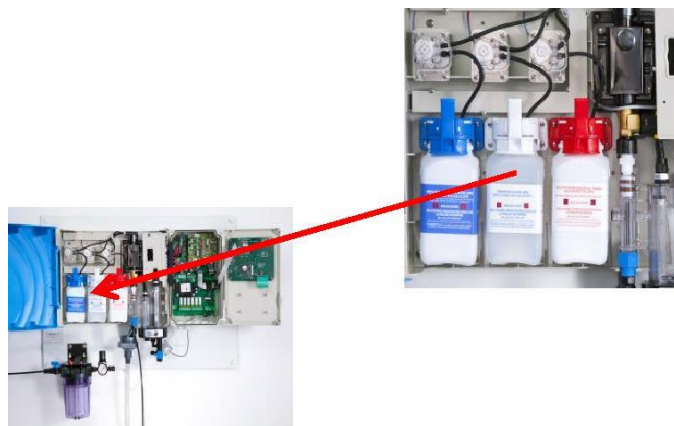


Figure 14: Reagents Bottles in Position

Caution

Do not refill the reagent bottles.

Do not mix or add reagent from other bottles.

Do not use any non-Blue I Technologies reagents.

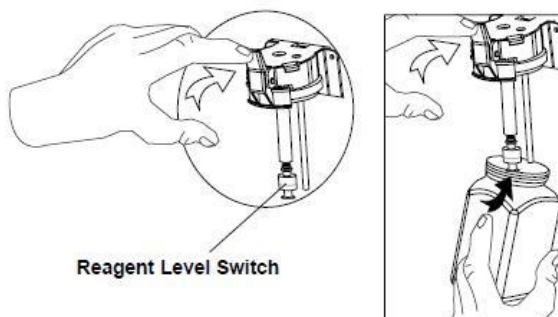


Figure 15: Reagent Bottles and Siphon Caps

Note: The Chlorine indicator, with the blue label, should connect to the blue siphon.



Figure 16: Labels of Reagent Bottles

8. Locate the **Pump** button on the HYDROGUARD HG-302 control panel.

Press the **Pump** button for ninety (90) seconds until the water visible through the viewing window appears with a red tint.

Note: The water will only have a visible red tint if it has a chlorine concentration above 0.2 PPM and below 10 PPM. If outside of this range, remove the colorimeter cap and confirm that reagents are being pumped.

9. Locate the red LED **CI** and **pH** displays in the HYDROGUARD control panel (Figure 17). A number should appear in both displays.

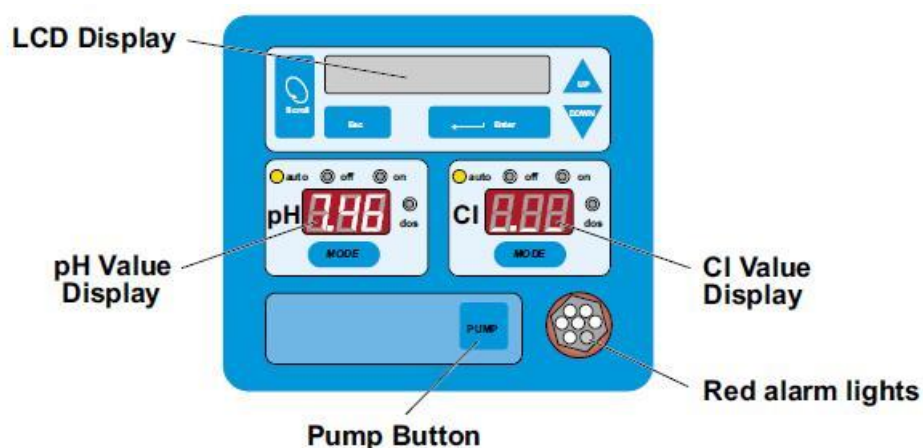


Figure 17: HYDROGUARD Control Panel

The pH value appears approximately ten (10) seconds after HYDROGUARD is turned on. The CI value appears one to four (1-4) minutes after HYDROGUARD is first operated, depending on the configuration.

If Chlorine Averaging is ON, the chlorine display is an average of the past four (4) readings. Therefore, the first number displayed will be 25% of the actual value, but the controller will act on the last reading regardless of the displayed value.

6.3. First Time Menu Setup

This section describes how to configure the settings (set points, alarms, and calibrations) through the HYDROGUARD control panel.

Caution:



HYDROGUARD's control board unit should not be opened except for initial installation and troubleshooting and should only be opened by a trained and approved technician.

6.3.1. HYDROGUARD Control Panel

The HYDROGUARD control panel, Figure 18, is a simple, intuitive interface for monitoring and controlling pool water quality and is divided into four distinct areas that are outlined in Table 2.

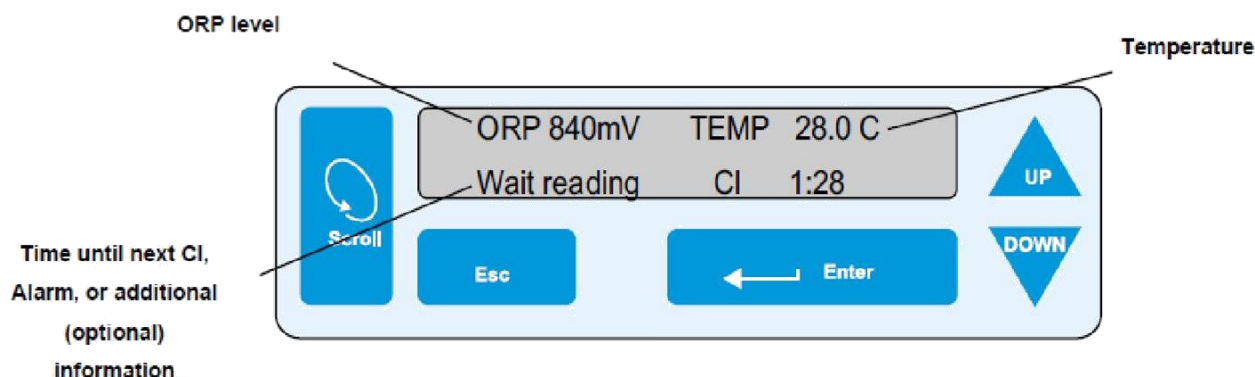


Figure 18: LCD Display and Menu Buttons

Table 2: HYDROGUARD Control Panel Overview

LCD monitoring window & menu controls	At the top of the control panel is a long LCD display.
Scroll	Scrolls through the menu.
Esc	Moves one level back in the menu without making changes.
Enter	Enters setting change mode and accepts setting change.
Up/Down	Changes value up or down.
pH	Red LED lighted display shows pH level of pool water, with the following buttons and lights.
Mode button	Changes the control mode of the acid/base dosing pump between automatic, off, and on. Controls relay 3.
Auto mode light	Automatic mode is when HYDROGUARD controls acid/base dosing, adding chemicals as necessary.
Off mode light	Relay is manually open. No acid or base is added.
On mode light	Relay is manually closed. Acid/base chemical is added as long as this light is on. For safety reasons, this mode automatically changes to Auto after 30 to 240 seconds (one pump period).
Cl	Red LED lighted display shows chlorine concentration in pool water, in parts per million, with the following buttons and lights.
Mode button	Changes control mode of chlorine dosing pump between automatic, Off, and On.
Auto mode light	Automatic mode is when HYDROGUARD controls chlorine dosing, adding chemicals as necessary.
Off mode light	Chlorine dosing is Off. No chlorine is added.
On mode light	Chlorine dosing is On. Chlorine chemical is added as long as this light is on. For safety reasons, this mode automatically changes to Auto after 30 to 240 seconds.
Pump button	Manually operates the reagent pump in the HYDROGUARD
Alarm light:	Lights when HYDROGUARD issues an alarm.

The LCD display on the control panel displays current water conditions in two rows of data. The top data row displays the measured ORP level and water temperature.

The bottom row alternates between various displays:

If HYDROGUARD does not issue an alarm, the bottom row displays a countdown timer to the next colorimetric chlorine test.

If no alarm is issued, and the flow measurement and/or turbidity features are operating, the bottom row also displays turbidity level (NTU) and/or water flow rate (m³/hour or GPM). When an alarm is issued, the bottom row displays the alarm.

Pressing the up arrow  once will change the display mode and cause the bottom row to alternate between the countdown Colorimeter timer and the alarm display.

If an alarm is issued, and the flow measurement and/or turbidity features are operating, the bottom row alternates every several seconds between displaying the alarm, the water turbidity level (NTU) and/or flow rate, and the Colorimeter countdown clock.

Pressing the up and down arrows ( & ) together will display the Langelier index for approximately five (5) seconds, and then returns to the previous display mode.

6.3.2. Menus

HYDROGUARD has two menu levels: Operator and Technician. The Operator menu includes settings that may be controlled by on-site pool operators. The Technician menu includes settings and calibrations that should be restricted to specially trained HYDROGUARD maintenance technicians. Each menu has a separate password. The technician level password may be used whenever a password is required, however the operator password will only be accepted in the operator menu.

Table 3 displays the operator menu functions and their description and Table 4 displays the menu functions with the minimum and maximum values for each.

Table 3: Operator Menu and Variable Limits

M	Name	Description
1	CI Set Point1	Controls CI Relay 1 - On/Off or Proportional
2	CI Set Point2	Controls CI Relay 2 - On/Off only
3	CI Calibrated to	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	CI Sensor was	
4	CI low alarm	Alarm when CI below this value
5	CI high alarm	Alarm when CI above this value
6	CI interval min	Minimum time between CI measurements
7	CI interval max	Maximum time between CI measurements
8	pH set point	Controls pH Relay 3 - On/Off or Proportional

9	pH Calibrated to	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	pH Sensor was	
1	pH low alarm	Alarm when pH below this value
1	pH high alarm	Alarm when pH above this value
1	ORP Set Point1	ORP set-point for emergency mode only
1	ORP Calibrated to	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	ORP Sensor was	
1	ORP low alarm	Alarm when ORP below this value
1	ORP High alarm	Alarm when ORP above this value + Open CI
1	Temp Set Point	Controls Temperature Relay 6
1	Temp Calibrated to	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	Temp Sensor was	
1	Temp Low Alarm	Alarm when Temp below this value
1	Temp High Alarm	Alarm when Temp above this value
2	Turbidity setpoint	Controls Turbidity Relay 4 - optional module
2	Turb. High alarm	Alarm when Turbidity above this value -
2	Alarm Delay	Time delay before Alarm Relay 5 closes
2	Flow low limit	Low flow limit for external flow meter
2	Flow K-factor	K-factor for external flow meter
2	Total Alkalinity	Manually entered for Langelier Index
2	Total Hardness	Manually entered for Langelier Index
2	TDS	Manually entered for Langelier Index
2	ORP Emergency Mode	Allows ORP mode to be used if CI
2	Language	Allows choice of language
3	System Reset	Restarts controller - safer than turning off and on

Table 4: Functions Menu - Minimum and Maximum Vvalues

Menu #	Name	Min	Max	Units
1	CI Set Point1	0	9.99	pp
2	CI Set Point2	0	9.99	pp
3	CI Calibrated to	0	9.99	pp
	CI Sensor was	0	9.99	pp
4	CI low alarm	0	9.99	pp
5	CI high alarm	0	10	pp
6	CI interval min	2	4	min
7	CI interval max	2	15	min
8	pH set point	6	8.5	--
	pH Calibrated to	6	8.5	--

9	pH Sensor was	6	8.5	--
10	pH low alarm	6	8	--
11	pH high alarm	6	9	--
12	ORP Set Point1	3	999	mV
13	ORP Calibrated to	3	999	mV
	ORP Sensor was	3	999	mV
14	ORP low alarm	3	750	mV
15	ORP High alarm	5	999	mV
16	Temp Set Point	0	50/ 122	°C /
17	Temp Calibrated to	0	50 / 122	°C /
	Temp Sensor was	0	50 / 122	°C /
18	Temp Low Alarm	0	50 / 122	°C /
19	Temp High Alarm	0	50 / 122	°C /
20	Turbidity setpoint	0	40	NT
21	Turb. High alarm	0	99.99	NT
22	Alarm Delay	0	10	min
23	Flow low limit	0	200	m ³ /
24	Flow K-factor	0	655	--
25	Total Alkalinity	0	600	pp
26	Total Hardness	0	600	pp
27	TDS	0	5000	pp
28	ORP Emergency Mode	Off	On	--
29	Language	Language Selection depending on model		
30	System Reset	n/a	n/a	--

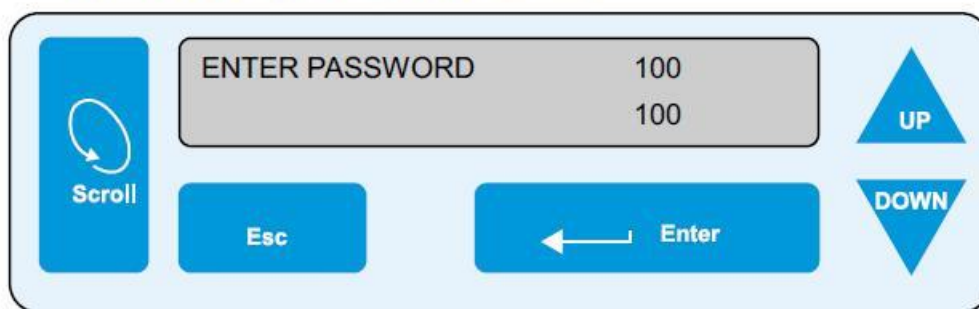
6.3.3. Configuring Settings in the Operator Menu

Each of the parameters in the operator menu is configured in the same way. The following procedure describes how to configure a typical setting:

1. Locate the desired parameter in the menu:

Press  (Scroll) until the desired parameter name appears in the LCD display. Press  (Enter) key.

Enter Password 100 appears in the LCD display.



2. Enter the Operator password (the technician password will also be accepted)

Press the up arrow  or down arrow  until the password number is reached.

Note: Holding the Scroll key while pressing up or down will advance the first digit. Holding the Up or down keys for an extended period of time will proceed through the numbers more quickly.

The factory-set operator password is 123. The operator password can only be changed by entering the current operator or technician password (see 4.5 Technician Menu Setup).

Press  (Enter) to accept the password.

The parameter name and current setting appear in the LCD display.

Press  (Enter). The LCD display shows the parameter and the current setting.

3. Enter the new parameter setting:

Press the up arrow  or down arrow  until the desired value is reached.

The second row of the LCD display, below the value that is being changed, shows the current value as shown in Figure 15.

4. Press  (Enter) to save the new setting or  (Esc) to abort without saving the new setting.

To change the settings of additional parameters, press  (Scroll) until the desired parameter appears in the LCD display and repeat steps 3 and 4 above to set the new parameter.

Note: The  (Scroll) button displays the next parameter in the list, so that the operator can check every parameter in the menu. There is no scroll-back option. To view or change a previous parameter in the menu, you must exit the menu by pressing  (Esc), and start the above procedure from the beginning.

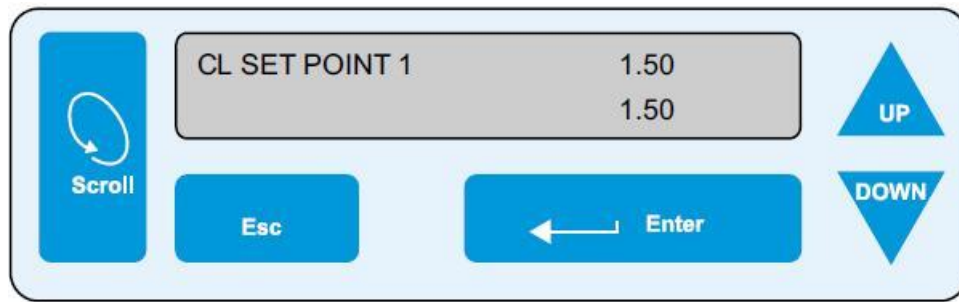
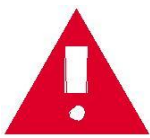


Figure 20: Changing a Parameter

6.4. Calibration

Parameters must be calibrated with measurements taken with external testing devices. Always use digital calibration devices, not the less accurate visual test kits. Alternatively, standard solutions may be used. Make sure the standard solution is not expired or contaminated prior to using. Follow the procedures below **EXACTLY** as instructed.

Caution:



ALWAYS take water for calibration from the sampling valve, **NOT** from pool. The controller should always be calibrated with water from the same source.

Note: Calibration is only required every 6 to 12 months. Minor deviations will exist between all testing equipment. These minor differences do not warrant the calibration of the colorimeter.

6.4.1. Chlorine Calibration

1. Open the water sampling valve. Let water flow while observing the colorimeter countdown timer in the LCD display.
2. Fill the sampling container when the countdown timer reaches zero (0).
3. Test the water sample for chlorine using a digital photometer.



4. Press (Scroll) three (3) times until **Cl Calibrated to** appears in the LCD display.

The top line will display “Cl Calibrated To” and a number. The number displayed is the last value someone entered for the calibration. The bottom line will display “Cl Sensor Was” and a number. This number is the sensor reading without any calibration at the time of the last calibration. If there is a large discrepancy between these two numbers, the sensor was calibrated improperly or the sensor needs to be replaced. The value displayed normally on the main screen and the value the controller uses to determine dosing rates is the calibrated value.

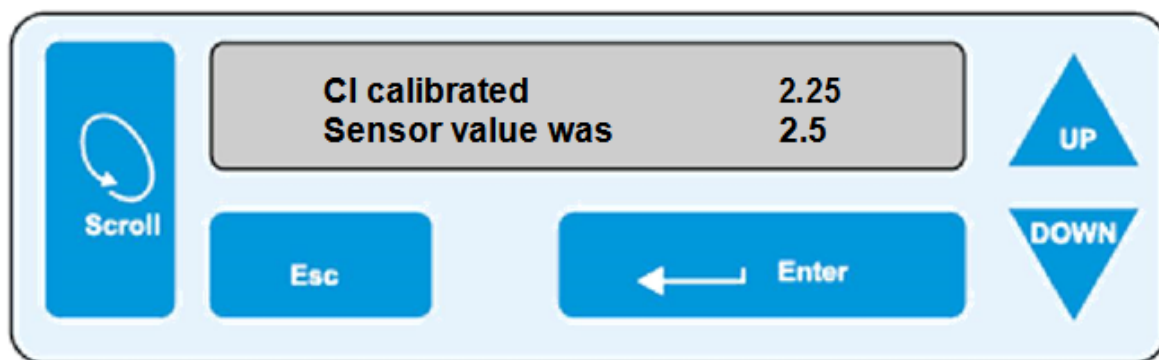


Figure 21: Calibrating a Parameter

Note: Chlorine calibration should always be performed within 25% of the set point. If the current chlorine level is 25% above or below the set point, do not perform calibration until the chlorine level is closer to the set point.

5. Press  (Enter).
6. Enter the password. Press the up arrow  or down arrow  until the password is reached.
7. Press  (Enter).
8. Press  (Enter) again.

The display will now show “Calibrate CI to” on the top line and “Sensor Reading” on the bottom line. The “Sensor Reading” is the current reading of the sensor with no calibration. The “Calibrate CI to” value is the new value which you want to set.

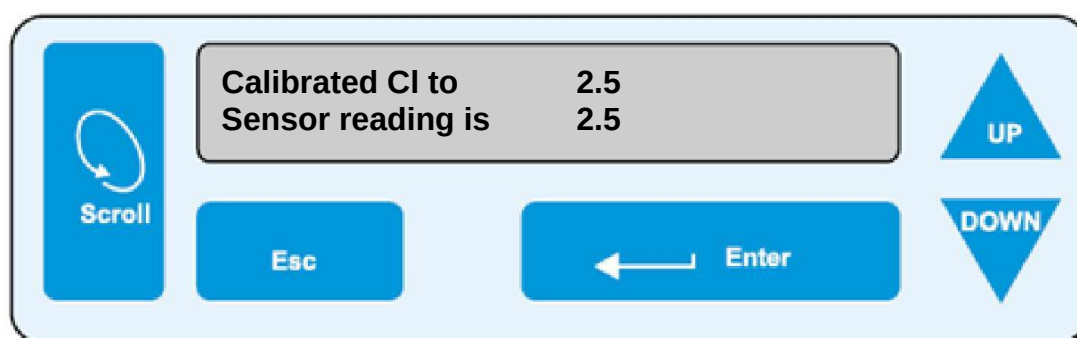


Figure 22: Sensor Reading After Calibration

9. Press the up arrow  or down arrow  until the value is the same as the value given by the digital photometer.

Note: The HYDROGUARD will not allow calibration above +/- 0.5ppm from the un-calibrated sensor reading. If the value given by the digital photometer is more than +/- 0.5ppm from the currently

calibrated value, retest the water in the digital photometer. If the value is still more than 0.5ppm above or below the calibrated value, try testing the water with another device. If there is still a deviation of more than 0.5ppm between the new digital photometer, there may be a problem with the HYDROGUARD colorimeter, which cannot be corrected by calibration alone.

10. Press  (Enter) to save the new calibration or  (Esc) to abort without saving.
11. Press  (Esc) to return to the main display.

6.4.2. pH Calibration

1. pH is calibrated using a Phenol Red or Buffer 7 solution.
2. Shut off the water inlet and outlet from the flow cell.
3. Remove the pH sensor and temperature probe from the flow cell.
4. Wipe the sensor probe with a dry cloth and submerge it and the (PT-100) temperature probe into a cup with the Phenol Red or Buffer 7 solution and wait for the reading to stabilize.

Note: The reading will not stabilize if the temperature probe is not in the buffer solution also.

5. Press  (Scroll) until **pH Calibrated to** appears in the LCD display.
6. Enter the password. Press the up arrow  or down arrow  until the password is reached.
7. Press  (Enter).
8. Press  (Enter) again.
9. Press the up arrow  or down arrow  until the value is the same as the value printed on the label of the Phenol Red or Buffer 7 Solution.
10. Press  (Enter) to save the new calibration or  (Esc) to abort without saving.
11. Press  (Esc) to return to the main display.

Note: pH and Redox (ORP) sensors tend to be slightly erratic in the first 24 hours they operate. If the above calibrations are performed immediately after these sensors are installed or replaced, repeat the calibration procedure in approximately 24 hours.

The temperature probe provides grounding and stabilizes the pH and ORP readings.

6.4.3. ORP (Redox) Calibration

ORP is calibrated using an ORP Standard Solution. A standard closest to the normal operating value should be used for calibration.

1. Shut off the water inlet and outlet from the flow cell.
2. Remove the ORP sensor and (PT-100) temperature probe from the flow cell.
3. Wipe the sensor probe with a dry cloth and submerge it and the temperature probe into a cup

with the ORP Standard Solution and wait for the reading to stabilize.

Note: The reading will not stabilize if the temperature probe is not in the buffer solution also.

4. Press  (Scroll) until **ORP Calibrated to** appears in the LCD display.
5. Press  (Enter).
6. Enter the password. Press the up arrow  or down arrow  until the password is reached.
7. Press  (Enter).
8. Press  (Enter) again.
9. Press the up arrow  or down arrow  until the value is the same as the value printed on the label of the standard solution.
10. Press  (Enter) to save the new calibration or  (Esc) to abort without saving.
11. Press  (Esc) to return to the main display.

6.4.4. Temperature Calibration

Take a sample of water from the flow cell.

1. Insert a digital thermometer into the sample.
2. Wait for the thermometer reading to stabilize.
3. Press  (Scroll) until **Temperature Calibrated to** appears in the LCD display.
4. Press  (Enter).
5. Enter the password. Press the up arrow  or down arrow  until the password is reached.
6. Press  (Enter).
7. The value that appears is the last calibrated value.
8. Press  (Enter) again.
9. Press the up arrow  or down arrow  until the value is the same as the independent digital thermometer.
10. Press  (Enter) to save the new calibration or  (Esc) to abort without saving.
11. Press  (Esc) to return to the main display.

Note: When the HYDROGUARD is initially turned on, the pH and ORP readings will continue to rise for the first 24-48 hours. If calibration is required, it is best to wait until the readings have

stabilized or recalibrate when the readings have stabilized.

6.5. Technician Menu Setup

The Technician menu includes advanced parameter settings that are accessible separately from the Operator menu. Anyone can view the settings, but only someone with technician password can change. This has been done to allow only those who are qualified to change the advanced controller settings. These are also settings that should not require frequent changes after the initial installation and set-up.

Table 5: Technician Menu Functions and Descriptions

Menu #	Name	Description
51	CI P factor	Proportional Factor for CI Relay 1
52	CI pump period	1 Pump cycle (on +off time) for CI Relay 1
53	CI pump freq	CI pump max pulses/min, 0 for on/off pump
54	CI Overfeed Time	Will open relay 1+2 if CI feeding continuously for this time
55	CI Averaging	Displays an average of the last 4 CI readings
56	CI < 0.1 Alarm	If CI drops below this level, Alarm indicated and Opens CI Relay 1+2
57	pH p factor	Proportional Factor for pH Relay 3
58	pH pump period	1 Pump cycle (on +off time) for pH Relay 3
59	pH pump freq	pH pump max pulses/min, 0 for on/off pump
60	pH Overfeed Time	Will open relay 3 if pH feeding continuously for this time
61	pH balance type	To Select if Acid or Base is being added to adjust pH
62	Flow Sensor	Will turn display of Flow rate on/off (only use if flow meter connected)
63	Flow Rate	Choose between metric and US units
64	Celsius/Farh	Choose between metric and US units
65	Temp Hysteresis	Value in degrees, below set-point which will close Temp Relay 6
66	Turbidity	Turns Turbidity Module ON/OFF (optional module)
67	NTU wiper interval	Interval for Turbidity Module Wiper to clean glass(optional module)
68	Minutes	Current Time for Data Logger
69	Hour	Current Time for Data Logger
70	Day	Current Time for Data Logger
71	Month	Current Time for Data Logger
72	Year	Current Time for Data Logger
73	Recording Interval	Time interval between readings stored on the on-board data logger
74	Address	Controller ID - used with external communication
75	Software Version	Current software version
76	Operator Password	Change operator password
77	Technical Password	Change technician password

Table 6: Technician Menu and Variable Limits

Menu #	Name	Min Value	Max Value	Units
51	Cl P factor	0.1	50	--
52	Cl pump period	0.5	4	min
53	Cl pump freq	0 (0 = on/off pump)	120	Max pulses/min
54	Cl Overfeed Time	0 (0 = off)	360	min
55	Cl Averaging	OFF	ON	--
56	Cl < 0.1 Alarm	OFF	ON	--
57	pH p factor	0.1	100	--
58	pH pump period	0.5	4	min
59	pH pump freq	0 (0 = on/off pump)	120	Max pulses/min
60	pH Overfeed Time	0 (0 = off)	360	min
61	pH balance type	Acid	Base	--
62	Flow Sensor	OFF	ON	--
63	Flow Rate	m ³ /hr	GPM	--
64	Celsius/Farh	°C	°F	--
65	Temp Hysteresis	0.1	1	°C or °F
66	Turbidity	OFF	ON	--
67	NTU wiper interval	1	60	min
68	Minutes	1	59	min
69	Hour	0	23	hour
70	Day	1	31	day
71	Month	1	12	month
72	Year	1	99	year
73	Recording Interval	1	240	min
74	Address	1	32	--
75	Software Version	n/a	n/a	--
76	Operator Password	1	999	--
77	Technical Password	1	999	--

6.5.1. Menu Feature Description

There are several features of the controller that are not immediately obvious from the menus.

Adaptive Chlorine Measurement Interval: The operator is able to select a minimum and maximum chlorine measurement interval. The controller will automatically vary between these limits based on measurement stability. An average measurement interval will be created between the minimum and maximum. The controller uses an advanced algorithm to determine which of the three measurement intervals to use based on the stability of the readings. In general, if the readings are unstable or are

far below the set point, the minimum interval will be used. As readings become more stable it will use the average or maximum interval as appropriate.

Water Savings Mode: To minimize the amount of water passing through the colorimeter, the controller operates in a water savings mode. The solenoid valve will open for 15 seconds to obtain a new fresh sample. The valve will close and the sample sequence will start. Once complete, the valve will remain open for an additional 30 seconds to completely flush the sample cell.

ORP Emergency mode: If a problem occurs with the colorimeter (unclean cell, stuck piston, communication error), or the customer runs out of reagents, the controller may be temporarily operated in ORP Emergency Mode. This mode must be started manually, by scrolling to the ORP Emergency Mode Menu, entering the password, and switching the mode to ON. If no colorimeter problem is present, the controller will not allow this mode to be entered. When in ORP Emergency mode, the ORP set point will be used to control Relay 1 (primary CI relay). When the problem is corrected, the controller will automatically resume operation in normal mode. If not corrected after 3.5 days, the controller will stop feeding CI.

CI < 0.1 alarm option: Whenever the CI measurement is < 0.1 ppm, the controller will disable relay 1 and relay 2. This alarm is provided as an extra level of safety against over chlorination due to bleaching of reagents. However, it complicates the start-up of the controller when the CI level is very low. Therefore, this alarm feature may be turned off. Blue I Technologies highly recommends that this alarm remain in use except for start-up.

CI and pH Overfeed timers: To prevent continued operation of equipment when a problem occurs, these timers will disable the CI or pH relays if the relay has been active for more than the selected time. An alarm will be issued and the controller will need to be reset in order to restart the relay operation. If 0 is entered, the feature is off.

Chlorine Averaging: This feature will only affect the displayed value; not the action of the controller. This feature is intended primarily to prevent operators from making constant changes due to minor, normal fluctuations in the measured chlorine level. Now, there is an option to have the average of the last four readings displayed on the screen or simply the previous reading. The controller will always act based on the last reading regardless of this setting.

6.5.2. Configuring Settings in the Technician Menu

Navigation within the Technician Menu is identical to the Operator Menu.

1. To enter the Technician Menu, press  (Scroll) to enter the Operator Menu and then press the up arrow and the down arrow together simultaneously  + ) until the menu display

changes.

2. Locate the desired parameter in the menu:

- A. Press  (Scroll) until the desired parameter name appears in the LCD display.
- B. Press  (Enter) key.

Enter Password 100 appears in the LCD display.

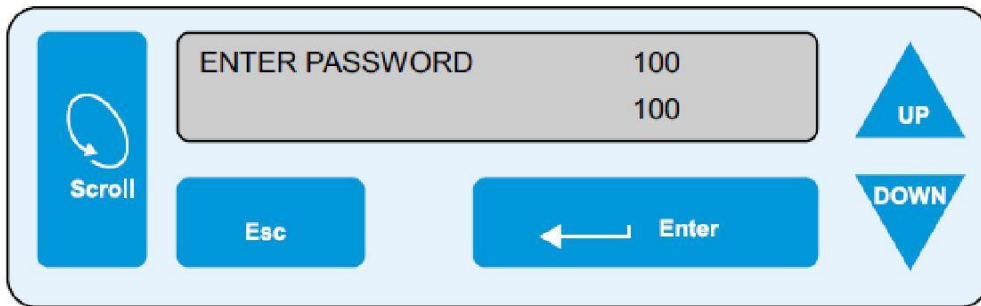


Figure 23: Entering Technician Password

3. Enter the Technician Menu password:

- A. Press the up arrow  or down arrow  until the password number is reached.
- B. Press  (Enter) to accept the password.
- C. The parameter name and current setting appear in the LCD display.

Note: The Technician Menu password is different from the Operator Menu password. The default Technician Menu password is 456 and if lost can only be reset by replacing the chipset.

4. Continue changing new parameter setting, as described in the Operator Menu.

Press the up arrow  or down arrow  until the desired value is reached.

6.6. Calibration and Initial Operation Checklist

Before leaving the site, perform the procedure in this section and record the requested values.

1. Calibrate the following HYDROGUARD parameters and enter the information into the table below. If pH and ORP are reading slightly low, do not calibrate as they will continue to increase for the first 24-48 hours.

Table 7: Technician Calibration Table

Date	Site	Technician's Name
Parameter	Controller Reading	External Device or Standard Value
Chlorine		
pH		
Redox (ORP)		
Temperature		

Perform the following tests:

2. Press the **pH Mode** button on the control panel to change the mode to **On**. Check that the dosing system is adding acid or base chemicals to the pool water.
3. Press the **pH Mode** button on the control panel to return the pH mode to **Auto**.
4. Press the **CI Mode** button on the control panel to change mode to **On**. Check that the dosing system is adding chlorine to pool water.
5. Press the **CI Mode** button on control panel to return chlorine mode to **Auto**.
6. Turn off the main circulation pump.

Check that the dosing systems are not adding any chemicals to the pool water.

7. Record the values in each menu:

Table 8: Parameters Values Record

Operator Menu	Value	Technician Menu	Value
CI Set Point1		CI P factor	
CI Set Point2		CI pump period	
CI low alarm		CI pump freq	
CI high alarm		CI Overfeed Time	
CI interval min		CI Averaging	
CI interval max		CI < 0.1 Alarm	
pH set point		pH p factor	
pH low alarm		pH pump period	
pH high alarm		pH pump freq	
ORP Set Point1		pH Overfeed Time	
ORP low alarm		pH balance type	
ORP High alarm		Flow Sensor	
Temp Set Point		Flow Rate	
Temp Low Alarm		Celsius/Farh	

Temp High Alarm		Temp Hysteresis	
Turbidity Set Point		Turbidity	
Turb. High Alarm		NTU wiper interval	
Alarm Delay		Recording Interval	
Flow low limit		Address	
Flow K-factor		Software Version	
Total Alkalinity		Operator	
Total Hardness		Technical	
TDS			

7. Routine Operation and Maintenance

Once installed by a qualified technician, HYDROGUARD can begin monitoring and controlling pool water quality. HYDROGUARD is specifically designed for easy operation; however some periodic maintenance is still required. Basic guidelines are provided in Table 6; however the actual schedule may vary depending on the actual conditions and use.

Table 9: Periodic Maintenance Schedule

Service Required	Frequency Required
Replacing Reagents	Every 4 to 8 weeks
Cleaning Pre-Filter	Check every 4 weeks, clean when visible dirt and oil
Calibration (pH, ORP, Temp, Cl)	Every 6 to 12 months
Replacing Reagent Pump Head and Tubes	Every 12 months

Basic Operation involves setting the desired parameters and monitoring the system for alarms. When operating normally, HYDROGUARD demands very little operator involvement.

Calibration: Sensor sensitivity and accuracy can degrade or drift over time. For this reason, HYDROGUARD settings must be periodically recalibrated and compared with measurements from other measuring devices, such as electronic photometers, pH sensors, and thermometers or compared to standard solutions like pH buffers or ORP standards.

Reagent Replacement: HYDROGUARD uses a very small amount (0.03 ml) of chlorine reagents each time water is sampled. The adaptive measurement interval will automatically vary the testing interval depending on water stability. This allows the two 500 ml bottles to last approximately 4 to 8 weeks. A Low Reagents alarm is issued when either one of the reagent bottles approaches depletion and should be replaced. If the reagents are not replaced before the reagents are depleted, the testing and chlorine dosing will stop and a No Reagents alarm will be displayed, therefore it is important to replace reagents before this occurs.

Filter Cleaning: The HYDROGUARD unit has a filter installed in its water supply pipe, which collects particles and impurities. It should be cleaned or replaced periodically, depending on water quality. The filter cover is clear allowing for a quick visual inspection to determine if cleaning is required.

Shut-down and Winterizing: In areas where temperatures drop below freezing, all water must be removed from the controller to prevent components from breaking and the probes must be removed and stored in a warm area and kept wet at all times. The probes will last for several years if properly treated but will not read properly if exposed to freezing temperatures or stored in air

Start-up and Preventive Maintenance: A preventative inspection and cleaning of components should be completed whenever the controller is restarted after a long (> 2 week) downtime. Likewise, the controller has several mechanical components that will wear out over time. To prevent future

problems, these components should be checked and/or replaced periodically. This is most easily accomplished at initial start-up, prior to the beginning of the pool season.

Troubleshooting: Occasionally problems will occur with the controller readings or chemical dosing. These problems are most often simple to correct. The troubleshooting section provides an outline to follow to help correct the problems easily.

7.1. Monitoring HYDROGUARD Alarms

HYDROGUARD issues alarms when it detects chemical levels that are above or below the allowed range. Every alarm is automatically displayed in the LCD status display and logged in the data logger. Most deviations in chemical levels, however, are automatically corrected. Thus, the internal alarms do not immediately activate an external alarm. A delay mechanism prevents false alarms from minor deviations that were automatically corrected. The external alarm is only activated after an internal alarm has been continuously active for a certain period of time, as defined by the operator. The **Alarm Delay** command in the Operator menu sets the number of seconds HYDROGUARD waits before closing **Relay 5**, the relay that operates the external alarm. Only one alarm is shown at a time based on importance and the order in which it should be fixed. For example, if the pH is high and the ORP is low, only the pH alarm will be indicated since lowering the pH will likely also correct the low ORP. All of the alarms are presented in Table 10.

Table 10: Alarms Description and Results

Alarm #	Alarm	Description	Result
A1	No flow	Flow switch in flow cell is off	No chemical dosing
A2	Low flow	external flow meter below minimum flow	No chemical dosing
A3	Check CLRMTR connect.	Communication error between colorimeter and colorimeter board	no chlorine dosing optional ORP emergency mode
A4	No reagents	Reagents are empty	no chlorine dosing - optional ORP emergency mode
A5	Stuck piston	Piston is not moving properly	no chlorine dosing - optional ORP emergency mode
A6	Unclean cell	glass in colorimeter is dirty	no chlorine dosing - optional ORP emergency mode
A7	Replace light	LED in colorimeter is not working	no chlorine dosing - optional ORP emergency mode
A8	Low reagents	Reagents are below 20%	--
A9	Chlorine < 0.1	Chlorine unusually low	no chlorine dosing
A10	High ORP	ORP above high limit	no chlorine dosing

A11	Low chlorine	Cl below low limit	--
A12	High chlorine	Cl above high limit	--
A13	Low pH	pH below low limit	--
A14	High pH	pH above high limit	--
A15	Low ORP	ORP below low limit	--
A16	High NTU	Turbidity above high limit	--
A17	EXTERNAL OFF	external flow switch is off	No chemical dosing
A18	Total Cl high	Total Cl above high limit	--
A19	Combine Cl high	Combined Cl above high limit	--
A20	Replace DPD3	DPD3 low	Total Cl testing stops
A21	Temp. low alarm	Temperature below low limit	--
A22	Temp. high alarm	Temperature above high limit	--
A23	Cl overfeed time	Cl dosing on for longer than max time	Cl dosing stops until reset
A24	pH overfeed time	pH dosing on for longer than max time	pH dosing stops until reset
--	No Emergency	No problem to allow ORP emergency mode	--

7.2.Replacing Reagents

HYDROGUARD issues a **LOW REAGENTS** alarm when the float at the end of one of the reagent siphons detects that one or both of the reagents is approaching depletion. After this time, HYDROGUARD will count down (internally) until the reagents are expected to be completely depleted and the Cl analysis and control will stop. The blue LED lights in the flow cell will flash continuously until the reagents are replaced or they are depleted, resulting in a **NO REAGENTS** alarm and an opening of the chlorine relays, preventing any additional chlorine from being added. Prior to receiving the **NO REAGENTS** alarm, replace the reagents:

1. Open the HYDROGUARD analyzing unit door.
2. Press the lever above the siphon cover on the chlorine indicator bottle and pull the bottom of the bottle until it drops down from the siphon.

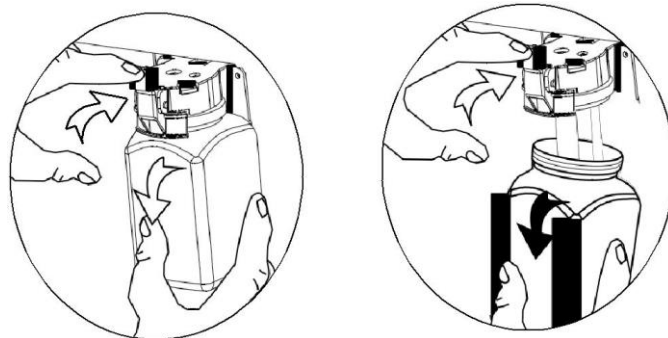


Figure 24: Replacing Reagent Bottles

3. Wipe the siphons with a dry cloth.
4. Perform the procedure to mix and install new reagent bottles, as instructed in section 4.2 Installing Reagents.



Caution: Do **NOT** pour remaining reagent fluid from the old bottle to new bottle. Mixing old and new reagent fluids destroys their effectiveness.

5. Repeat the steps above with the chlorine buffer bottle.
6. Close the analyzing unit door.
7. Locate the **Pump** button on HYDROGUARD's control panel.
8. Press the **Pump** button for fifteen (15) seconds until the water visible through the viewing window has a red tint.
9. Locate the LCD detail readings window in the HYDROGUARD control panel.
10. Check if the **Low Reagent** alarm message appears in the bottom row.
Locate the red LED **Cl** and **pH** readings indicators in the HYDROGUARD control panel.

A number should appear in both displays.

7.3. Cleaning the Filter

The HYDROGUARD unit is sent to the site mounted on a mounting panel. Several other units are mounted on the panel, alongside the controller. One of the mounted components is a water filter, which filters out sand, rust, coarse debris, oil, and other impurities in the sampled pool water. These impurities may clog the HYDROGUARD's internal pipes, contaminate the sensors, or dirty the analyzing cell, reducing its accuracy. This filter must be cleaned regularly as it becomes clogged with debris and impurities. The frequency at which the filter requires cleaning depends entirely on how much debris is in the pool water. The following procedure describes how to remove, clean, inspect, and if necessary, replace HYDROGUARD's water filter:

1. Locate the water filter, mounted below the HYDROGUARD unit, and the valve that is located on the water supply pipe.

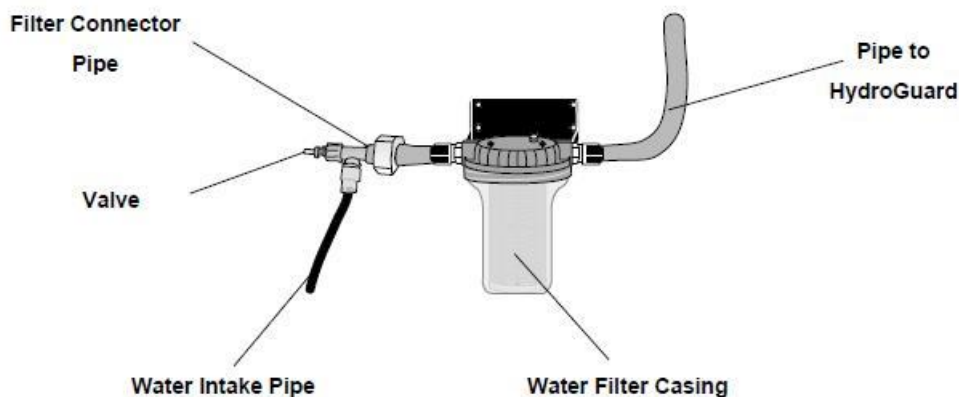


Figure 25: HYDROGUARD Unit's Water Filter

2. Turn off water supply to HYDROGUARD by shutting the water intake valve.
3. Remove the filter.

- A. Push the air relief valve 1 for the filter top to reduce the vacuum and unscrew the filter casing 2.
- B. Remove the filter from the filter housing 3.

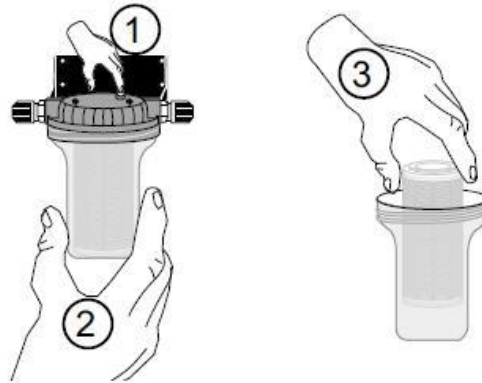


Figure 26: Releasing Filter from Casing

4. Inspect the filter.
 - A. Remove any loose debris with your fingers.
 - B. Replace the filter if any part of the filter fabric is torn.
5. Wash the filter under running water.
 - A. Point the high-pressure water jet towards the filter at a right angle and spray until all debris has been dislodged.
 - B. Spray the water jet into the filter casing until all debris in the casing has been dislodged.

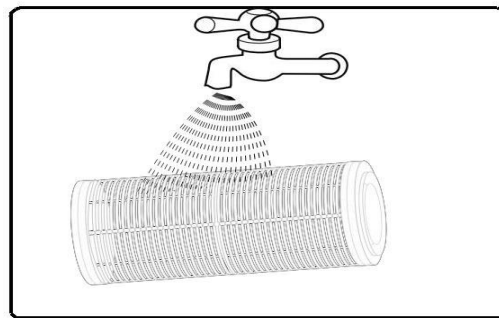


Figure 27: Washing the Filter

6. Return the filter into place.
 1. Place the cleaned or new filter into the casing and verify the gaskets at each end are compressed.
 2. Verify the casing's O-ring is in place and screw casing to filter base, until the gasket is firmly compressed against the filter connector pipe.
7. Open the water supply valve.

7.4. Shut-Down and Winterizing

The HYDROGUARD controller is designed to keep the probes submerged even if there is no flow to the controller. However, if the controller is going to be offline for an extended period of time and/or exposed to freezing temperatures, it must be winterized to prevent damage to the controller and the probes.

1. Remove each probe from the flow cell.
2. Fill the rubber caps (that were on the new probes) with tap water or preferably KCl (potassium chloride) solution and insert over the end of each probe.
3. Screw the plastic cap over the top of each probe to protect the connector.
4. Store in a safe location that will not drop below freezing, preferably in the original probe box for additional protection.
5. Drain the flow cell completely by opening the sampling valve on the bottom. Leave the valve in the open position to allow air to completely dry the cell.
6. Remove the reagent bottles and flush each pump tube by inserting the pump tube in a container of fresh water and pressing the pump button for at least 90 seconds.
7. Remove the pump tubes from the water containers and press the pump button for an additional 90 seconds to remove any water.
8. With the solenoid valve in the open position, turn off the power to the controller. If the solenoid is in the closed position, the unions at the top and bottom of the solenoid should be loosened to allow the colorimeter and solenoid to completely drain.
9. Check the security of the controller doors to ensure a weatherproof seal.

7.5. Start-up and Preventive Maintenance

After the controller (or flow) has been off for a long period of time (> 2 weeks), a few simple checks should be done during the initial start-up. Several components may need to be cleaned and some mechanical parts may be replaced as preventative maintenance.

1. Remove the colorimeter cap and clean the quartz glass using a cotton swab.
2. Remove the solenoid and check the tip for corrosion (this may occur if shut down improperly) and check the plastic stop for deterioration. The corrosion can usually be cleaned away and the solenoid will continue to work properly. After start-up, confirm that the water is completely stopped when the solenoid shuts. If not shutting properly, it must be cleaned or replaced.
3. Inspect the pump tubes for cracks or signs of significant wear and replace if necessary (see 5.5.1).
4. Install new reagents and press the pump button for 90 seconds to prime the tubes.
5. Inspect the pump needles (in the colorimeter cap) to ensure that droplets are forming and falling properly. Replace if necessary.
6. Replace probes in the flow cell, close the sampling valve and turn on flow immediately to re-wet the probes.
7. Recalibrate the controller: Cl, ORP, pH. ORP and pH will likely require 24-48 hours to re-stabilize and will require re-calibration at this time.

7.5.1. Replacing Pump Head and Tubes

If the pump head and/or tubes are cracked, appear significantly worn, or are no longer functioning properly, they should be replaced to ensure consistent operation and control.

1. Turn off the power to the HYDROGUARD controller.
2. Remove the tubes from the pump head and the needles in the colorimeter cap by holding the top of each needle and pulling the tube gently.
3. Remove the tubes from the reagent bottles and wipe off any excess reagent (the DPD will stain so be careful).
4. Unscrew the two (2) screws on the face of the pump head. Save the screws.
5. Remove the pump head by pulling gently and sliding the pump head off of the motor assembly.
6. Slide the new pump head onto the motor assembly ensuring that the slot in the pump head matches the notch in the motor shaft. DO NOT force the pump head onto the motor assembly; it should easily slide into place.
7. Rotate the pump head and slide the alignment pins into the motor assembly.
8. Replace the two (2) screws to reattach the pump head.
9. Attach the new pump tubes by pressing the tubes onto the connectors on the end of the pump head.
10. Insert the pump tube leading to the bottom of the pump head into the appropriate reagent bottle.
11. Attach the pump tube from the top of the pump head to the needle on the colorimeter cap by holding the needle and gently pressing the tube onto the connector.

7.6. Troubleshooting

The following procedures instruct how to locate, evaluate, and fix a problem when HYDROGUARD issues an alarm or indicates suspect chemical levels. Table 11 outlines some controller problems that may generate a false alarm, potential causes and solutions. Table 12 outlines some possible problems associated that may occur but will not generate an alarm and their potential causes and solutions.

Table 11: Troubleshooting for Specific Alarms

Alarm	#	Description	Symptom	Solution / Suggestion
No Flow	A1	Not enough water is reaching the controller. Stop all chemical dosing (all relays are open)	No reading	Increase flow and check flow switch wire connection on board. Check that the switch is not stuck.
Low Flow	A2	Water flow rate in main circulation pipe is lower than the flow limit. Stop all chemical dosing (all relays are open)	No dosing	Check the circulation pipes, not a controller problem.
Check Colorimeter Connect	A3	No communication with the colorimeter	No Cl measurements	Check wiring between colorimeter sensor and colorimeter board. Change colorimeter sensor case if problem continues.
No Reagents	A4	Stops colorimeter testing and chlorine dosing. Displays no CL __. __ value in control panel.	No reading	Check reagent level, change bottle if needed. Make sure the sensor is not stuck.

Stuck Piston	A5	Piston is not moving properly within the colorimeter.	No reading	Wait for the 2nd measurement and check visually. Clean the colorimeter assembly. Make sure the colorimeter connection is well connected to the "mixer" on control panel. An authorized technician may open the cover and check the coils connection. Try to push the piston from the top down
Unclean Cell	A6	Impurities have accumulated in the colorimeter analyzing cell. Stops chlorine feeding and activates relay, external alarm.	No reading	Clean tube. An authorized technician, may open the cover and clean the sensor/lamp. Change colorimeter if repeating.
Replace Light	A7	The LED light in the colorimeter is not working. Insufficient connection on board.	No reading	Resolder LED connection. Change colorimeter assembly.
Low Reagents	A8	Starts when reagent level reaches 20%, and notifies how many days are left until the reagents are depleted.	No symptom	Message - NOT an error. Info indicating replacement is soon needed.
High ORP	A10	Redox (ORP) is above alarm level. Opens Relay 1 and Relay 2. No Cl feed. Used as a safety measure to override the free chlorine measurement.		Compare to manual reading! Check if unstable reading is due to grounding. Check the correct set point. Recheck in 24H and recalibrate.
Low ORP	A15	Redox (ORP) is below alarm level.		Check/replace probe. Check connection to board. Change probe if necessary.
Low Chlorine	A11	Free Chlorine level is below alarm level.	Low reading Alarm	Compare to manual reading! Check reagent flow from bottle to colorimeter. Check/clean solenoid valve (including spring). Check correct water flow. Verify piston movement ("mixing"). Check dosing system from relay to dosing pumps. Replace reagents.
High Chlorine	A12	Free Chlorine level is above alarm level.	High reading Alarm	
Total CL high	A18	Total Chlorine level is above alarm level.	High reading Alarm	
Low pH	A13	Acid/base level is below alarm level.	Low reading Alarm	Compare to manual reading! Check if Stable reading is due to grounding. Check the correct set point. Check connection to board. Change probe if necessary.
High pH	A14	Acid/base level is above alarm level	High reading Alarm	
High NTU	A16	NTU level is above alarm level.	High reading Alarm	Check constant reading. Compare to manual reading. Check wiper movement. Clean sensor window. Change if necessary.

Alarm	#	Description	Symptom	Solution / Suggestion
External Off alarm	A17	Connections External Flow Switch indicating no flow. Stop all chemical dosing (all relays are open)	Problem not coming from Circulation system. No external flow sensor installed	Check shortcut with DVM. Make connection on I/O board with flow sensor on connections 5 + 6 or wire to complete circuit. Change Board if necessary.
Combine CL high	A19	Combine chlorine level is above alarm level.	High reading Alarm	
Replace DPD3	A20		No reagent in the right bottle out of the three.	Replace reagent.
Temp Low	A21	Temp level is below alarm level.	Low reading Alarm	Probe connection failure.
Temp High	A22	Temp level is above alarm level	High reading Alarm	
Cl pump Overfeed time	A23	Chlorine pump has been active for more than a pre-determined time limit and has shut off for safety reasons. Determine problem then do a System Reset.	No Dosing and Cl will reduce.	1. Check set point for CL2 . Check dosing pump malfunction/low rate. 2. Check for leakage or blockage in all the injection pipes from chlorine tank to pump and from pump to injection point. 3. Check for chlorine in the tank. If everything seems to be OK and the problem repeats consider changing the overfeed time limit to a higher
Chlorine < 0.1	A9	Chlorine level is below 0.1 PPM. Opens Relay 1 and Relay 2 - no Cl feed.	No chlorination	Compare to manual reading! Check reagent flow from bottle to colorimeter. Check/clean solenoid valve (including spring). Check correct water flow. Verify piston movement ("mixing"). Check dosing system from relay to dosing pumps. Replace reagents.
pH pump Overtime	A24	pH pump has been active for more than a pre-determined time limit and has shut off for safety reasons. Perform a System Reset to turn back on.	No Dosing, will reduce pH	1. Check set point for pH. Check dosing pump malfunction/low rate. 2. Check for leakage or blockage in all the injection pipes from the chlorine tank to pump and from pump to injection point. 3. Check for chlorine in the tank. If everything seems to be OK and the problem repeats consider changing the overfeed time limit to a higher number

ORP Emergency Mode		Problem with Colorimeter Reading. ORP is now controlling chlorine until problem is resolved (up to 3.5 days only).	Should use with care. This method has disadvantages that will not reflect same results as normal operation.	Function may be enabled, after no solution for alarms A3/4/5/6/7.
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Table 12: Troubleshooting Other Problems

Problem / Symptoms	Potential Cause	Solution / Suggestion
Display not functioning or is displaying odd numbers.	Connection between boards is loose	Check all connections between boards.
	pH and ORP wires reversed.	Trace pH and ORP wires from probe back to board.
	Chipset is loose or pin bent.	Check that no pins on the chipset are bent and it is in completely and correctly.
Controller won't power up.	Fuse is blown.	Check and Replace fuse above main power supply
	I/O board has been damaged due to improper electrical installation.	Check for burn marks on I/O board. Recheck for proper wiring -- confirm all neutrals and grounds in contact are from the same power supply.
ORP and pH readings are very far from normal value.	ORP and pH wires are reversed or disconnected.	Trace wires back to Control Board and confirm.
	ORP or pH probe is bad.	Replace faulty probe.
Unstable ORP and pH Readings	Poor Grounding	Check: PT100, I/O board ground, ORP and pH wire grounding.
pH and/or Cl not Feeding	In menu change mode	Hit escape to exit out of menu -- return to auto mode.
	Overfeed Safety Shut-off	Check for overfeed alarm -- system reset to restore (adjust overfeed time if needed).
Chlorine Measurement is Zero or Low	Reagent Pumps not Primed or broken.	Prime for 90 seconds - confirm pumps work properly and droplets form and drop from each needle.
	Chlorine too high (~20ppm) and is bleaching reagents.	Dilute and test manually -- controller will operate fine once back at normal level.
	Solenoid not shutting completely	Confirm that water stops flowing when reading starts (timer gets to zero). Unscrew solenoid and clean the tip -- check filter for holes.
	Using wrong or not original reagents or reagent expired date passed.	Make sure reagents are in good conditions, replace if needed.
	Needles Blocked/Damaged	Press pump and confirm that droplets forming as expected

Problem / Symptoms	Potential Cause	Solution / Suggestion
Zero or Low Reading than Normal	Bad Pump tube and solution is bypassing/returning to reagent bottle.	Check by raising solenoid above pump and/or turning off for an hour and then seeing if reagent comes out immediately when pumped.
	Piston sticks once in a while. Note: Ver4.0 will present "Stack Piston" Alarm.	View for a while and see if stacks.
	Valve malfunctioning.	Check/Clean valve and spring. Add grease. Replace valve if necessary.
	Needle is cracked or tube split at needle.	Needle will be black on outside -- DPD occasional does not drop properly b/c not flowing through Needle
Chlorine Measurement Inconsistent	CI averaging on	Check if CI averaging on in Tech menu -- turn off if not wanted.
	Calibrated at wrong level	Enter calibration -- enter password and press enter to accept reading from colorimeter.
	Valve malfunctioning.	Check/Clean valve and spring. Add grease. Replace valve if necessary.
	Needs Calibration (near set point)	If +/- 25% of set point, re-calibrate.
	LED/colorimeter bad	LED likely not selective or not reading proper zero of 650. Check with Tech Module and replace.
CI Display Showing '---'	No flow	Reestablish proper flow to colorimeter and wait for next test Cycle.
	Colorimeter disconnected	Check to see if ORP Emergency mode is indicated. Determine problem with colorimeter: check connections, clean cell, etc.
Sample Cell or Colorimeter is Overflowing	Too much water to the Inlet	Reduce Inlet flow and/or pressure - a regulator may be required.
	Outlet blocked or not downward sloping	Redirect Outlet so constant downward slope and no sharp bends in the tube
Colorimeter Needles Scaling	Water is flowing too high in colorimeter	Reduce flow/pressure of water to colorimeter, replace the needles.
No power	Check the fuse	Replace if needed.

7.7. Replacing Components

The following procedures describe how to replace certain HYDROGUARD components.

Caution:



The following procedures should only be performed by properly qualified and trained HYDROGUARD controller technicians.

Warning: Disconnect all power supplies to the HYDROGUARD controller before opening the control unit door. Replacing any parts of HYDROGUARD without the expressed written authorization of Blue I Technologies Ltd. or the qualified representative who supplied the product may void the warranty.



Blue I Technologies Ltd. takes no responsibility, written or implied, for installation or maintenance of HYDROGUARD that is not performed by a properly trained and certified HYDROGUARD technician.

7.7.1. Replacing Sensors

Replacing the pH or ORP sensor:

1. Turn off the inlet and outlet water to the flow cell and the power to the controller.
2. Open the doors of both the analyzing module and the control module.
3. Locate the sensor in the flow cell that is to be replaced. The specific sensor may be identified by the label on the wire or by tracing the wire from the control panel back to the sensor.
4. Remove old sensor from the flow cell:
 - a. Unplug the sensor's wires from the sensor by grabbing the connector at the top end of the sensor and unscrewing the connector.
 - b. Unscrew the sensor from the flow cell.
 - c. Pull the sensor up until its glass tube or metal probe clears the hole.
5. Prepare the new sensor to be installed:
 - a. Open the replacement sensor's box and remove the sensor by the metal connector.
 - b. If the sensor has a rubber or plastic plug at the tip of the glass tube, remove the plug and shake the sensor. The protecting oil inside the glass tube may interfere with the sensor's readings.
6. Install the new sensor:
 - a. Hold the sensor by its metal connector, with the glass tube pointing down, and insert the glass tube into a hole in the flow cell.
 - b. Screw the probe into place. **DO NOT OVERTIGHTEN.**
 - c. Screw the sensor wire onto the probe.

7.7.2. Replacing the Temperature Probe

1. Turn off the inlet and outlet water to the flow cell and the power to the controller.
2. Open the doors of both the analyzing module and the control module.

3. Remove the four (4) wires from the temperature probe in the control module.
4. Remove old sensor from the reading cell:
 - a. Unscrew the compression fitting from the temperature probe.
 - b. Pull the probe up until it clears the fitting.
5. Install the new sensor:
 - a. Insert the temperature probe into the fitting.
 - b. Screw the compression fitting around the probe.

7.7.3. Replacing the Flow Switch

6. Turn off the inlet and outlet water to the flow cell and the power to the controller.
7. Open the doors of both the analyzing module and the control module.
8. Locate the flow switch attached to the flow cell.
9. Disconnect the flow switch wires from the I/O module.
10. Remove the inlet connection to the old flow switch.
11. Remove the flow switch from the flow cell.
12. Pull the flow switch wires gently to completely remove them from the controller.
13. Insert the new flow switch on the flow cell.
14. Insert the inlet connection on the flow switch.
15. Route the flow switch wires back to the connection on the I/O module and connect the wires to points 3 and 4 on the input switch terminal block.
16. Close the controller doors and turn on the water and power and ensure proper operation.

7.7.4. Replacing Reagent Siphons

17. Turn the power off to the controller.
18. Disconnect the two (2) red wires from the reagent level connector on the colorimetric module.
19. Remove the four (4) mounting screws.
20. Install the new reagent siphons.
 - a. Attach the four (4) mounting screws.
 - b. Connect the two (2) red wires to the colorimetric module.

7.7.5. Replacing the sensor

Turn the power off to the controller.

Disconnect the two (2) red wires from the reagent level connector on the colorimetric module. Unscrew the old sensor by hand and pull out the sensor along with its two (2) red wires. Install the new sensor by first pushing the two (2) red wires into the sensor tube.

Screw in the sensor by hand.

Reconnect the two (2) red wires to the colorimetric module.

7.7.6. Replacing Reagent Pumps

1. Turn the power off to the controller.
2. Disconnect both pipes from the reagent pump.
3. Remove the four (4) mounting screws.
4. Disconnect the Red and Blue wires from the Pumps connector on the colorimetric module.
5. Install the new pump and reconnect (in this order): the pipes, the 4 screws and the wires to the colorimeter module.
6. Push the pump button until reagents are injected into the colorimeter cell (approximately 90 Sec.).

Note: If only the motor is to be replaced, the pump head will need to be removed and reattached. See 5.5.1, Replacing Pump Head and Tubes.

7.7.7. Replacing the Colorimeter Module

The HYDROGUARD water quality controller has a self-contained chlorine analyzing cell to determine the chlorine concentration in the pool water.

Follow the procedure below to replace the colorimetric module.

1. Turn off the water inlet and outlet from the flow cell and turn off the controller power.
2. Open the doors of both the analyzing module and the control module.

Note: There are no serviceable parts in the colorimeter units.

Warning:



Attempting to open the colorimeter unit will void the warranty.

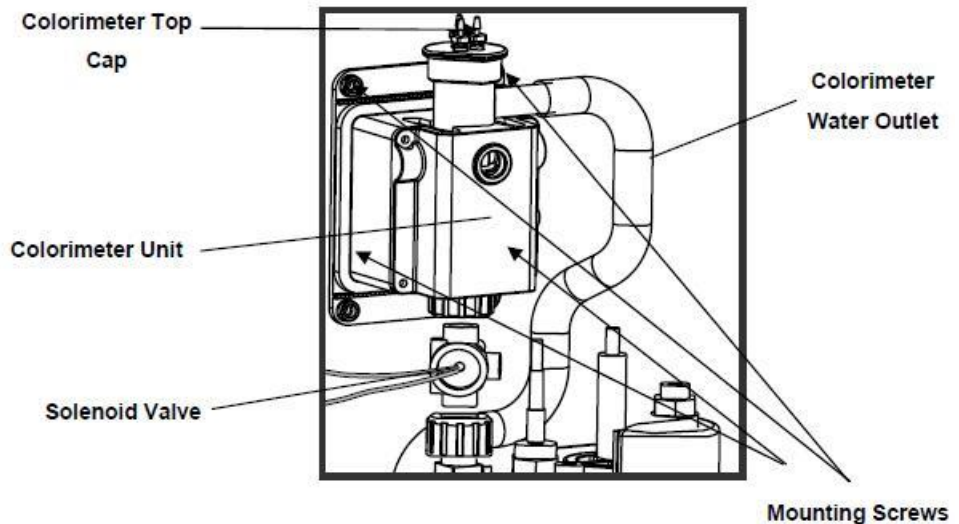


Figure 28: Colorimetric Unit

3. Locate the colorimetric cell unit in the analyzing sets.
 - a. Remove the top cap from the colorimetric unit. Make sure not to touch the reagent injection needles in the cap.
 - b. Disconnect the outlet tube from the colorimetric unit.
 - c. Unscrew the union between the solenoid valve and the Colorimeter.
 - d. Unscrew the four (4) mounting screws that hold the Colorimeter to the HYDROGUARD housing.
 - e. Open the control module door.

- f. Trace the wires from the Colorimeter to the control module connector. A total of four wire pairs (2x4) are connected to the control module (4 connected to the "MIXER" terminal block and 4 to the "SENSOR" terminal block).
 - g. Disconnect the Colorimeter 's wires from the Colorimeter module.
5. Connect a new Colorimeter unit:
 - a. Hand tighten the union between Colorimeter and the solenoid valve until the Colorimeter is tightly connected to the valve. Check that the O-ring is still in place.
 - b. Screw the Colorimeter to the HYDROGUARD analyzing module housing with the four mounting screws.
 - c. Place the top cap on the Colorimeter unit.
 - d. Re-connect the outlet tube to the Colorimeter.
 - e. Pass the wires from the new colorimeter through the gasket into the control module.
 - f. Connect the wires to the "MIXER" and "SENSOR" terminal blocks as indicated on the colorimeter module.
6. Recheck all connections.
7. Close the HYDROGUARD analyzing module door.
8. Turn on the power and restore flow to the flow cell.
9. Confirm that the colorimeter is operating properly.

7.7.8. Replacing Colorimeter Solenoid Valve

1. Turn the water inlet and outlet to the flow cell and turn off the controller power.
2. Release the top union connecting the solenoid valve to the Colorimeter module.
3. Detach the cable from the solenoid valve.
4. Unscrew the solenoid valve intake tube.
 - a. Unscrew and disconnect the sampled water supply pipe from the solenoid intake pipe, at the bottom of the solenoid valve.

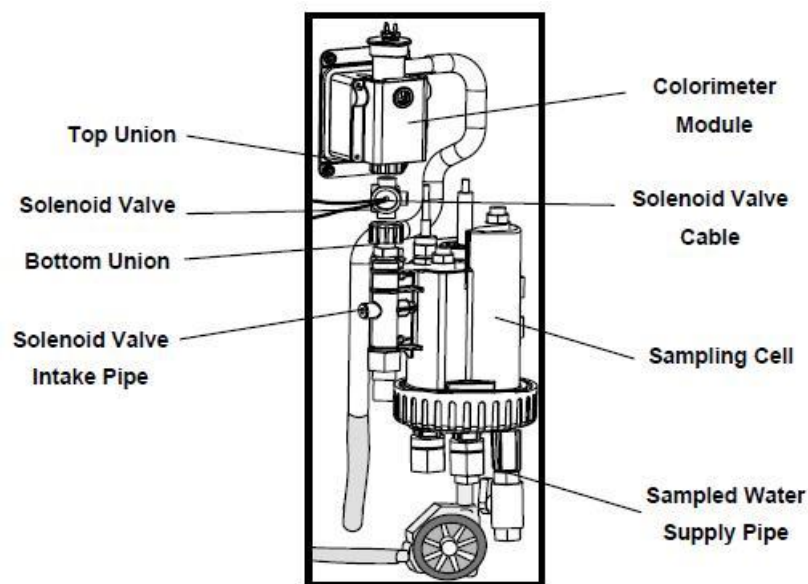


Figure 29: Solenoid Valve with Colorimeter Module and Flow Cell

5. Disconnect the valve from the unions above and below.

6. Connect the new solenoid valve.
 - a. Connect the bottom of the new valve to the intake pipe.
 - b. Insert a coin into the slot at the bottom of the intake pipe, and turn until the intake tube is firmly connected to the new valve.
 - c. Connect the top union to the valve and to the bottom of the Colorimeter unit and tighten.
 - d. Connect the solenoid valve cable to the Colorimeter module.

7.7.9. Replacing Control Panel Module

Disconnect the power supply to the unit before opening the control unit.



1. Disconnect the flat cable plug from the card. 1
2. Unscrew the four (4) mounting screws. 2
3. Put in the new card and tighten the four (4) mounting screws. 2
4. Connect the flat cable plug to the card. 3

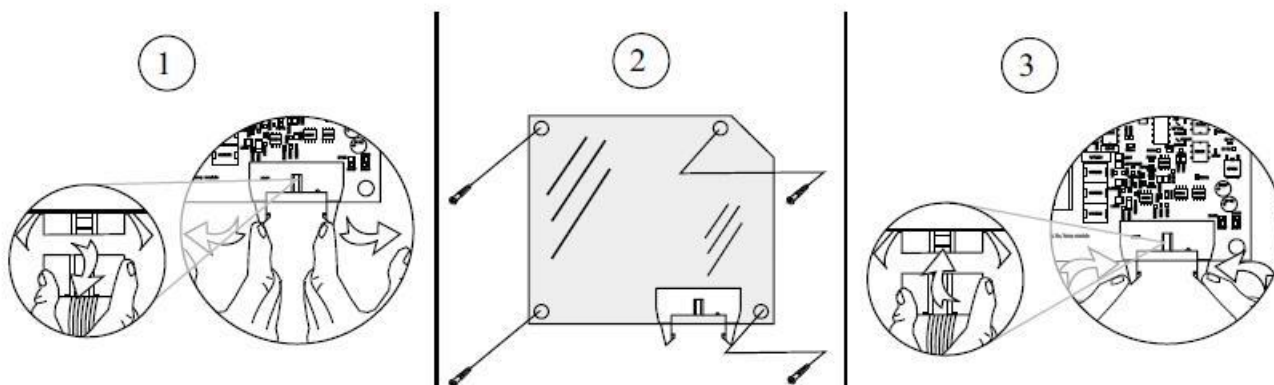


Figure 30: Replacing All Types of Electronic Cards

7.7.10. Replacing I/O Module



Disconnect the power supply to the unit before opening the control unit.

1. Disconnect the flat cable plug from the card. 1
2. Unscrew the four (4) mounting screws. 2
3. Put in the new card and tighten the four (4) mounting screws. 2
4. Connect the flat cable plug to the card. 3

7.7.11. Replacing pH, Redox, and Temperature Module



Disconnect the power supply to the unit before opening the control unit.

1. Disconnect the flat cable plug from the card. 1
2. Unscrew the four (4) mounting screws. 2
3. Put in the new card and tighten the four (4) mounting screws. 2

4. Connect the flat cable plug to the card. 3

7.7.12. Replacing Colorimetric Module



Disconnect the power supply to the unit before opening the control unit.

Before replacing this card, first remove the pH, Redox and Temperature card as described in section 5.5.9.

1. Disconnect the flat cable plug from the colorimetric card. 1
2. Unscrew the four (4) mounting screws. 2
3. Put in the new colorimetric card and tighten the four (4) mounting screws. 2
4. Connect the flat cable plug to the colorimetric card. 3
5. Replace and reconnect the pH, Redox and Temperature sensors card as described in section 5.5.9.

7.7.13. Module Software Update

Each electronic module has a microcontroller chip (IC) with its own unique software. Whenever a module's software is updated, its chip must be replaced by a new version with the new software.



1. Turn OFF the power to HYDROGUARD.
2. Locate the chip that needs to be replaced
3. Remove the chip carefully by prying up each end a little at a time with a thin screwdriver.
4. Install the new chip in the same location. Please note in the figure that the chip and the board each have a directional mark. The chip **must** be positioned so that these directional marks are aligned.

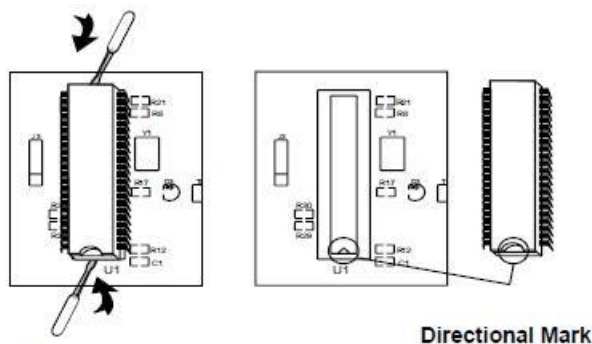
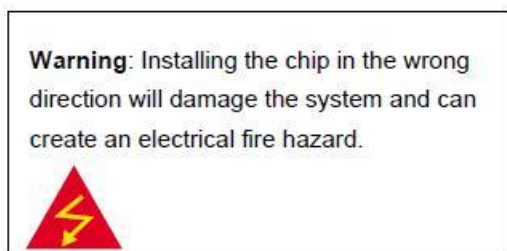


Figure 31: Installing the New Chip

8. Optional Controller Features

8.1. Total Chlorine

The Total Chlorine Controller measures both the Free Available Chlorine (FAC) and the Total Chlorine (TC); combined chlorine (CC) is calculated. The free chlorine is the active chlorine in the water. When chlorine is added to water, hypochlorous acid (HOCl) is formed, which is the active agent that actually disinfects the water. However, its reaction with nitrogen-based compounds creates inorganic or organic chloramines, also known as "combined chlorine".

A high level of combined chlorine may cause **excessive** chlorine odor, respiratory problems, and eye/skin irritation. Likewise, chloramines are relatively inactive and therefore do not aid in sanitizing. The most common way to remove CC is to add a level of chlorine equivalent to 10 times the CC level. Alternatively, many complimentary sanitizing systems, like UV will lower CC levels while providing additional water sanitation. Maintaining a low CC level will provide an overall cleaner and safer system with less noticeable chlorine odor. Total Chlorine HYDROGUARD has an alarm for high combined chlorine. This alerts the operator when treatment is required to lower the CC level.

8.2. Installation

If the controller has been ordered as a total chlorine unit, this section may be skipped. This section is for upgrading an existing controller to include the Total Chlorine monitoring.

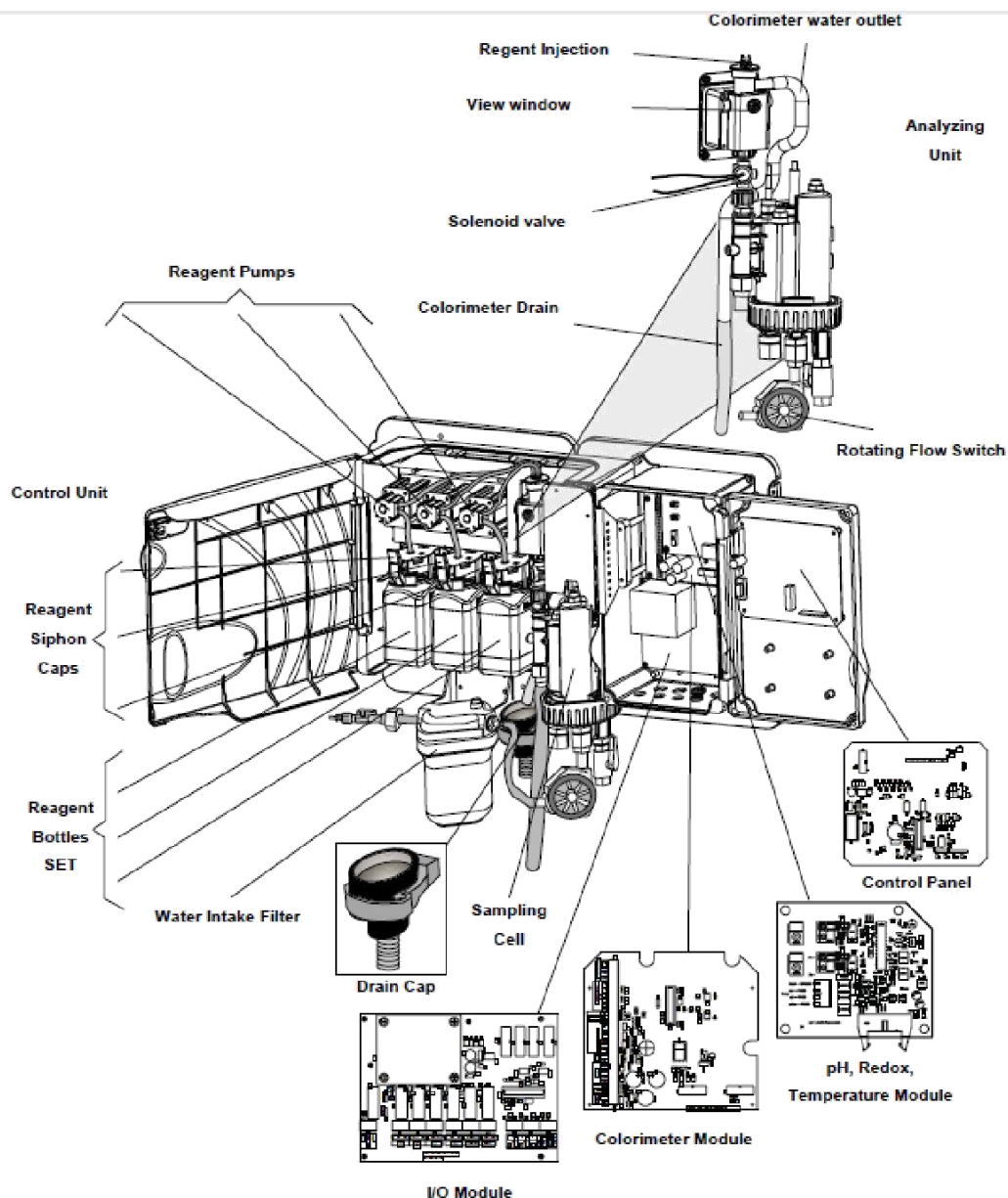
8.2.1. Required Parts

Starting with a complete HG-302 controller, the following components are required to upgrade to

Total Chlorine Control:

- Reagent Holder (1)
- Float Switch (1)
- Peristaltic Pump (1)
- Pump Tubing (1)
- Colorimeter Cap with 3 needles (1)
- Integrated Chips (2)

A diagram of a complete total chlorine controller is presented in Figure 32 below.



8.2.2. Installation of Hardware



Warning: Before installing any new hardware, turn off all power supplies to the HYDROGUARD.

8.2.2.1. Installing new Colorimeter Cap

1. Remove the existing colorimeter cap by lifting up
2. Remove the tubes from the DPD1 and buffer from the existing cap
3. Insert the DPD1 and Buffer tubes into two of the needles on the new cap
4. Press the new cap into place

8.2.2.2. *Installing the Peristaltic Pump*

1. Attach the mounting plate of the pump to the mounting holes on the support board to the right of the other two pumps, using the four supplied screws.
2. Route the pump wires to the main electronics box by following the wires from the existing pumps.
3. Loosen or remove the screws holding the top of the conduit cover in place.
4. Push the wires into the conduit and feed through to the opening on the right.
5. Push the wires through an available opening in the rubber gasket (make sure to push through near the final connection).
6. Connect the wires to the Colorimeter board.
7. Find the section labeled "Buffer DPD Pumps."
8. Connect the red and blue wires at the top two terminal connections (the connections are marked red and blue).

8.2.2.3. *Installing the Pump Tubing*

1. Remove the screws on the cover plate to the peristaltic pump
2. Feed the pump tubing through the wheels on the pump, starting at the bottom
3. Feed the bottom pump tube into the hole at the top of the reagent holder
4. Connect the end of the top tube to one of the needles on the colorimeter cap by pushing firmly

8.2.2.4. *Installing Reagent Holder and Float Switch*

1. Attach the Reagent Holder on the mounting board to the right of the other reagent bottle caps, using the supplied screws.
2. Route the wires for the float switch through the conduit and to the electrical box by following the wires from the existing float switches.
3. Loosen or remove the screws holding the conduit cover in place.
4. Feed the wires through the conduit, following the path of the existing float switches.
5. Push the wires through an available opening in the rubber gasket (make sure to push through near the final connection).
6. Connect the wires to the Colorimeter board.
7. Find the section labeled "Reagent DPD Level."
8. Connect the wires to the top two terminal connections (it doesn't matter which red wire goes into which connector).

8.2.2.5. *Installing the New Integrated Chipsets*

1. Turn OFF the power to the HYDROGUARD Controller.
2. Locate the chip on the control panel.
3. Carefully remove the existing chip, as shown in Figure 33.
4. Reinstall the chip labeled "CP E TCL..." making sure to line up the direction marks as shown in Figure 33.

5. Locate the chip on the Colorimeter Module.
6. Carefully remove the existing chip.
7. Reinstall the chip labeled “COLCONT E TCL...” making sure to line up the direction marks as shown in Figure 2.

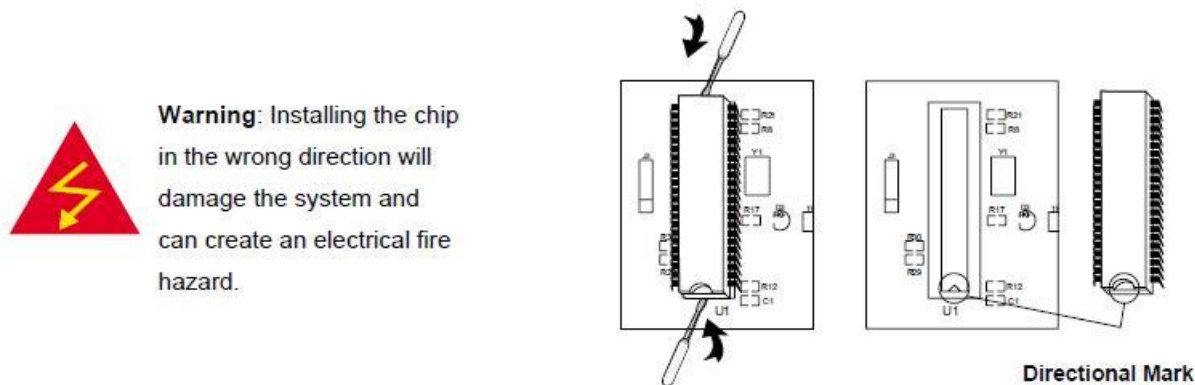


Figure 33: Installing the new chip

8.2.2.6. Installing DPD 3 Reagent

The DPD 3 reagent bottle is installed the same as the DPD 1 and Buffer solution bottles and will be in a 600 ml bottle labeled as DPD 3, however priming is different.

1. Place the reagent bottle in position.
2. Remove the cap from the reagent bottles.
3. Place the opening of the reagent bottle below the bottle siphon on the right.
4. Lift the bottle up until the opening reaches the bottle siphon cap.
5. Push the lever above the siphon cover away from you, and push the reagent bottle up.
6. Push the bottom of the bottle into position.

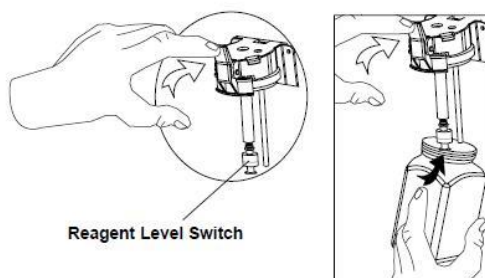


Figure 34: Reagent Bottles and Siphon Caps

7. Locate the **Pump** and Up button on the HYDROGUARD HG-302 control panel.
8. Press the **Pump** and Up button together for ninety (90) seconds until the reagent drops are visible through the DPD 3 needle.

8.2.3. New menus and settings

The total chlorine monitoring requires a few additional menus and alarms and requires a few additional settings to be configured before operating the controller.

8.2.3.1. Operator Menu

The following table lists the parameters in HYDROGUARD's Operator menu:

Table 13: Operator Menu

Menu #	Name	Description
1	CI Set Point1	Controls CI Relay 1 - On/Off or Proportional
2	CI Set Point2	Controls CI Relay 2 - On/Off only
3	CI Calibrated to	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	CI Sensor was	
4	CI low alarm	Alarm when CI below this value
5	CI high alarm	Alarm when CI above this value
6	CI interval min	Minimum time between CI measurements
7	CI interval max	Maximum time between CI measurements
8	pH set point	Controls pH Relay 3 - On/Off or Proportional
9	pH Calibrated to	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	pH Sensor was	
10	pH low alarm	Alarm when pH below this value
11	pH high alarm	Alarm when pH above this value
12	ORP Set Point1	ORP set-point for emergency mode only
13	ORP Calibrated to	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	ORP Sensor was	
14	ORP low alarm	Alarm when ORP below this value
15	ORP High alarm	Alarm when ORP above this value + Open CI relays 1+2
16	Temp Set Point	Controls Temperature Relay 6
17	Temp Calibrated to	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	Temp Sensor was	
18	Temp Low Alarm	Alarm when Temp below this value
19	Temp High Alarm	Alarm when Temp above this value
20	Turbidity set point	Controls Turbidity Relay 4 - optional module
21	Turb. High alarm	Alarm when Turbidity above this value - optional module
22	Alarm Delay	Time delay before Alarm Relay 5 closes
23	Flow low limit	Low flow limit for external flow meter
24	Flow K-factor	K-factor for external flow meter
25	Total Alkalinity	Manually entered for Langelier Index
26	Total Hardness	Manually entered for Langelier Index
27	TDS	Manually entered for Langelier Index
28	Total CI High Alarm	Alarm when Total CI is above this level
29	Comb. CI High Alarm	Alarm when Combined CI is above this level
30	ORP Emergency	Allows ORP mode to be used if CI measurement problem
31	Language	Allows choice of language
32	System Reset	Restarts controller - safer than turning off and on

8.2.3.2. Alarms

The table below lists and describes the HYDROGUARD alarms, and the relays they activate.

Table 14: Table of Alarms

Alarm #	Alarm	Description
A1	No flow	Flow switch on flow cell is off
A2	Low flow	External flow meter below minimum flow
A3	Check CLRMTR connect.	Communication error between colorimeter and colorimeter board
A4	No reagents	Reagents are empty
A5	Stuck piston	Piston is not moving properly
A6	Unclean cell	Glass in colorimeter is dirty
A7	Replace light	LED in colorimeter is not working
A8	Low reagents	Reagents are below 20%
A9	Chlorine < 0.1	Chlorine unusually low
A10	High ORP	ORP above high limit
A11	Low chlorine	Cl below low limit
A12	High chlorine	Cl above high limit
A13	Low pH	pH below low limit
A14	High pH	pH above high limit
A15	Low ORP	ORP below low limit
A16	High NTU	Turbidity above high limit
A17	EXTERNAL OFF	External flow switch is off
A18	Total Cl high	Total Cl above high limit
A19	Combine Cl high	Combined Cl above high limit
A20	Replace DPD3	DPD3 low
A21	Temp. low alarm	Temperature below low limit
A22	Temp. high alarm	Temperature above high limit
A23	Cl overfeed time	Cl dosing on for longer than max time
A24	pH overfeed time	pH dosing on for longer than max time
--	No Emergency	No problem to allow ORP emergency mode

8.2.3.3. Technician Menu

The following table lists the parameters in HYDROGUARD's Technician menu:

Table 15: Technician Menu

Menu #	Name	Description
51	CI P factor	Proportional Factor for CI Relay 1
52	CI pump period	1 Pump cycle (on +off time) for CI Relay 1
53	CI pump freq	CI pump max pulses/min, 0 for on/off pump
54	CI Overfeed Time	Will open relay 1+2 if CI feeding continuously for this time
55	CI Averaging	Displays an average of the last 4 CI readings
56	CI < 0.1 Alarm	If CI drops below this level, Alarm indicated and Opens CI Relay 1+2
57	pH p factor	Proportional Factor for pH Relay 3
58	pH pump period	1 Pump cycle (on +off time) for pH Relay 3
59	pH pump freq	pH pump max pulses/min, 0 for on/off pump
60	pH Overfeed Time	Will open relay 3 if pH feeding continuously for this time
61	pH balance type	To Select if Acid or Base is being added to adjust pH
62	Flow Sensor	Will turn display of Flow rate on/off (only use if flow meter connected)
63	Flow Rate	Choose between metric and US units
64	Celsius/Farh	Choose between metric and US units
65	Temp Hysteresis	Value in degrees, below set-point which will close Temp Relay 6
66	Turbidity	Turns Turbidity Module ON/OFF (optional module)
67	NTU wiper interval	Interval for Turbidity Module Wiper to clean glass (optional module)
68	Minutes	Current Time for Data Logger
69	Hour	Current Time for Data Logger
70	Day	Current Time for Data Logger
71	Month	Current Time for Data Logger
72	Year	Current Time for Data Logger
73	Recording Interval	Time interval between readings stored on the on-board data logger
74	Tot Chlor ON/OFF	Turns the total CI testing ON or OFF
75	Chlor Ratio	Ratio of Free CI tests to Total CI tests
76	Address	Controller ID - used with external communication
77	Software Version	Current software version
78	Operator Password	Change operator password
79	Technical Password	Change technician password

8.3. Activate Total Chlorine Monitoring

1. Enter the Technician Menu (by pressing scroll and up and down together).
2. Scroll to " Total Chlorine ON/OFF".
3. Change to "ON" (the default is - OFF).
4. Locate the LCD displays in the HYDROGUARD control panel. A number should appear in the display (TCI - 0.00).

Setting Total Chlorine Ratio (Testing Interval)

1. Press Scroll to enter the operator menu.
2. Press up and down together to go to the Technician Menu.
3. Scroll to "Chlorine Ratio".
4. Set the Chlorine Ratio according to how often you want to measure TC.
5. The ratio may be set between 1 and 30.
6. Example: If the ratio is 1, a TC measurement will be taken every time a FAC measurement is made (i.e. every 4 minutes); if the ratio is set to 10, a TC measurement will be taken after 10 FAC measurements are made (i.e. every 40 minutes).

Setting High Combined and Total Chlorine Alarms

1. Enter the Operator Menu by pressing Scroll.
2. Scroll until "Total Chlorine High Alarm" is reached.
3. Press Enter.
4. Enter Password.
5. Select the High Total Chlorine Alarm Level, using the up and down buttons.
6. Press Enter.
7. Press Scroll again – Display should read "Combined Chlorine High Alarm".
8. Press Enter.
9. Select the High Combined Chlorine Alarm Level, using the up and down buttons.
10. Press Enter.
11. Press Esc, to return to normal operation.

Troubleshooting Specific to Total Chlorine

The troubleshooting of the HYDROGUARD controller with total chlorine will be the same as the troubleshooting of the standard HYDROGUARD controller. However, there are a few conditions that may exist with the total chlorine controller that do not occur with the standard unit.

The table below outlines these additional troubleshooting issues:

Table 16: Troubleshooting for Specific Alarms

TC is high and FAC is zero or low	Chlorine Level is too high (~20ppm) and is bleaching reagents	Dilute and test manually -- controller will operate fine once back in normal level
TC is reading higher than FAC	FAC was calibrated but TC did not increase or decrease as expected	a) Perform system reset and wait for next TC reading
		b) upgrade to new software version

		V4.0 or later
FAC is reading high	DPD3 is being trapped on piston	Replace silicon piston with new version

8.4. Flow Meter



Caution: Prior to opening the controller or installing any electrical components, turn off all power supplies to the controller.

8.4.1. Selecting and Location

The exact location of the flow meter will depend on the specific piping arrangement. Several factors should be considered in order to provide maximum safety and accuracy.

Safety: In order to prevent chemicals from being added when there is no flow to the pool, the flow meter should be installed in the main return line after the filter.

Accuracy: in order to ensure accuracy, the flow meter should be installed in a straight run of pipe following the minimum requirements listed in Table 10.

Table 17: Minimum Installation Distance from Pipe Fittings

Fitting	Distance to Flow meter
Flange	10 x ID
90° elbow	25 x ID
Reducer	15 x ID
Valve	50 x ID
Outlet	5 x ID

Likewise, if the pipe is not completely full of water or air bubbles are present, the flow meter should be installed in the side or bottom of the pipe to prevent interference. Lastly, the flow meter cable is 8m (26.4 ft) and may be cut or extended up to 15m (48.7 feet) as needed. The distance to the controller must not exceed this maximum.

8.4.2. Hardware and Plumbing Installation

1. Drill an appropriate size hole (based on the saddle clamp and flow meter) in the main return pipe from the filter based on the criteria listed in 0.
2. Install the saddle clamp.
3. Lubricate the sensor o-ring with a silicone lubricant. DO NOT use a petroleum-based lubricant, as this may deteriorate the o-ring.
4. Insert the flow meter into the saddle clamp, aligning the tab on the flow meter with the notch on the saddle clamp.
5. Hand tighten the flow meter cap. DO NOT use tools or over tighten.

8.4.3. Electrical Installation

6. Pass the flow sensor cable through an open gland on the bottom of the controller.
7. Connect the three wires from the sensor cable to the last terminal block on the lower right corner of the I/O Module, following the color order indicated on the module.

The sensor cable may be cut or extended up to a maximum distance of 15m (48.7 feet) as needed.

8.4.4. First Time Set-up and General Operation

Although the flow meter is connected, it will not operate until it is set up in the controller menu.

8.4.4.1. *Operator Menu*

1. Press Scroll until "23 Flow Low Limit" appears on the display and press Enter.
2. Enter the operator or technician password and press Enter.
3. Enter the minimum flow rate and press Enter.
4. The units of the flow rate can be set to GPM or m³/hr in the technician menu.
5. If the flow rate drops below this value, all relays will open, except the alarm relay.
6. Press Scroll again and "24 Flow K Factor" appears on the display and press Enter.
7. Enter the operator or technician password and press Enter.
8. Using the table provided with the flow meter, enter the k-factor based on the pipe size, fitting, and units (GPM or m³/hr)

8.4.4.2. *Technician Menu*

1. Press up and down together to enter the technical menu.
2. Press Scroll until "62 Flow Sensor ON/OFF" appears in the display and press Enter.
3. Enter the technician password and press Enter.
4. Select the appropriate units, GPM or m³/hr and press Enter.
5. Press Scroll again and "63 Flow Rate" appears in the display and press Enter.
6. Enter the technician password and press Enter.
7. Select the appropriate units, GPM or m³/hr and press Enter.

The flow meter should now be active. Confirm that the flow rate appears on the LCD display. If it is not active, perform a system reset.

8.5. Turbidity

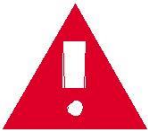
8.5.1. Overview

The turbidity upgrade will provide a measurement of the turbidity in NTU (Nephelometric Turbidity Units). This provides a consistently objective evaluation of the overall water quality. A body of water with high turbidity will appear dull or hazy. What constitutes "high" will vary based on the specific body

of water but in general water with turbidity above 0.5 NTU will appear hazy. Deeper bodies of water will appear dull and hazy at a lower turbidity than shallow water.

High turbidity may be a result of poor filtration or unbalanced water chemistry. The turbidity value will provide an indication that one of these conditions exists and action is required to improve the water quality. In many cases the turbidity can be reduced by adding a flocculent to the filter which will improve filtration. A turbidity relay is contained in the controller and will operate when the turbidity increases above set point. This may be connected to a pump for flocculent or other equipment used to reduce turbidity, providing an automatic response and maintaining clear water without requiring operating intervention. Likewise, if the turbidity ever exceeds a pre-set limit, the controller will set off an alarm indicating that attention is required.

8.5.2. Installation



Caution: Prior to opening the controller or installing any electrical components, turn off all power supplies to the controller.

There are five (5) wires, contained in a single cord, from the sensor that must be connected to the controller. The standard wire length is 22 ft (7m), and may be cut or extended up to 650 ft (200m) as needed. The turbidity flow cell and sensor must be securely mounted using appropriate hardware for the mounting location. Unfiltered water will need to be supplied to the turbidity flow cell at a flow between 0.25 to 1 GPM and less than 30 psi (2 bar)

8.5.3. Hardware and Plumbing Installation

1. Mount the Turbidity Flow Cell, using the supplied bracket (or other mounting hardware as appropriate) such that the inlet and outlet ports are horizontal and the flow tube extends down.
2. Insert the sensor into the opening of the flow tube, ensuring that the notch in the top of the opening matches the rod on the sensor.
3. Hand-tighten the connector to secure the sensor and seal the turbidity flow cell.
4. Connect the water supply to the turbidity flow cell. Follow the flow indicated by the arrow on the flow cell.

The flow rate should be between 0.25 and 1 GPM (15-60 gal/hr or 50-225 L/hr) and the pressure should not exceed 30psi (2 bar). The inlet and outlet connections are 1/4" FNPT.

8.5.4. Electrical Installation

1. Install the Turbidity Module (electronics card) on the inside, bottom of the control panel door using the supplied screws.
2. Connect the turbidity module to the I/O module using the supplied ribbon cable and any open connector (the connectors on both boards operate in parallel).
3. Pass the sensor cable through an open glad on the bottom of the controller.
4. Connect the wires from the sensor cable to the terminal block on the lower left corner of the Turbidity Module, following the color order indicated on the module.

The sensor cable may be cut or extended up to a maximum distance of 650 feet (200m) as needed.

8.5.5. Relay Wiring and Use

Wiring of the NTU (turbidity relay) is identical to wiring of all other relays and should be connected to a pump- dependent (interlocked) power supply.

1. Verify that the power switch or circuit breaker to the pump-dependent power source is off.
2. Connect the earth ground wire of the power supply to the ground return wire from the controlled external turbidity equipment.
3. Connect the neutral wire of the power supply to the neutral wire from the controlled external turbidity equipment.

4. Connect the line (live) wire of the power supply to the connector marked 'C' (common) on the NTU terminal block.
5. Connect the line (live) wire of the controlled external turbidity equipment to the normally open (N_O) or normally closed (N_C) connection on the NTU terminal block.



Caution: Each relay connection is limited to 4 amps, to prevent overheating. The relays may show a higher rating but do not connect equipment exceeding 4 amps.

8.5.6. First Time Set-up and General Operation

Although the turbidity unit is connected, it will not operate until it is set up in the controller menu.

8.5.6.1. Operator Menu

If the NTU relay is connected to external equipment:

1. Press Scroll until "Turbidity Set Point" appears on the display and press Enter.
2. Enter the operator or technician password and press Enter.
3. Enter the turbidity set point value and press Enter.

With or without the NTU relay connected to external equipment:

1. Press Scroll until "Turbidity High Alarm" appears on the display and press Enter.
2. Enter the operator or technician password and press Enter.
3. Enter the turbidity high alarm value and press Enter.

8.5.6.2. Technical Menu

1. Press up and down together to enter the technical menu.
2. Press Scroll until "Turbidity ON/OFF" appears in the display and press Enter.
3. Enter the technician password and press Enter.
4. Press up to turn the turbidity sensor on and press Enter.
5. Press Scroll until "Turbidity Wiper Interval" appears in the display and press Enter.
6. Enter the technician password and press Enter.
7. Enter the wiper interval (2 minutes is recommended) and press Enter.

The turbidity unit should now be active. Confirm that the turbidity value appears on the LCD display. If it is not active, perform a system reset.

8.5.7. Relay and External Equipment Operation

The relay will operate in an ON/OFF mode. Whenever the measured turbidity is below the set point, the relay will remain open (no power to normally open connection). Whenever the measured turbidity is above the turbidity set point, the relay will close (power will be supplied to the normally open connection).

If the measured turbidity is above the turbidity high alarm, the alarm on the controller will be activated. The

NTU relay will remain closed (power to the normally open connection) even during an alarm.

9. Relays, Menus and Alarms

This chapter lists HYDROGUARD's relays, menu commands, alarms, and system technical data.

9.1. Relays

Table 18: List of Relays

Relay	Control
1	Cl 1 - Main chlorine system
2	Cl 2 - Secondary chlorine system
3	pH - Acid or base dosing
4	NTU (Numeric Turbidity Units) - Controls the injection of flocculants and coagulants. Used only with the optional turbidity module. See turbidity module documentation.
5	Alarm - Activates an external (third party) alarm when certain alarm types are registered.
6	Temperature - Controls water temperature by activating the water heating system.

9.2. Operator Menu

Table 19: Operator Menu

Menu #	Name	Description
1	Cl Set Point1	Controls Cl Relay 1 - On/Off or Proportional
2	Cl Set Point2	Controls Cl Relay 2 - On/Off only
3	Cl Calibrated to Cl Sensor was	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
4	Cl low alarm	Alarm when Cl below this value
5	Cl high alarm	Alarm when Cl above this value
6	Cl interval min	Minimum time between Cl measurements
7	Cl interval max	Maximum time between Cl measurements
8	pH set point	Controls pH Relay 3 - On/Off or Proportional
9	pH Calibrated to pH Sensor was	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
10	pH low alarm	Alarm when pH below this value
11	pH high alarm	Alarm when pH above this value
12	ORP Set Point1	ORP set-point for emergency mode only
13	ORP Calibrated to ORP Sensor was	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
14	ORP low alarm	Alarm when ORP below this value
15	ORP High alarm	Alarm when ORP above this value + Open Cl relays 1+2

16	Temp Set Point	Controls Temperature Relay 6
17	Temp Calibrated to Temp Sensor was	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
18	Temp Low Alarm	Alarm when Temp below this value
19	Temp High Alarm	Alarm when Temp above this value
20	Turbidity setpoint	Controls Turbidity Relay 4 - optional module
21	Turb. High alarm	Alarm when Turbidity above this value - optional module
22	Alarm Delay	Time delay before Alarm Relay 5 closes
23	Flow low limit	Low flow limit for external flow meter
24	Flow K-factor	K-factor for external flow meter
25	Total Alkalinity	Manually entered for Langelier Index
26	Total Hardness	Manually entered for Langelier Index
27	TDS	Manually entered for Langelier Index
28	ORP Emergency Mode	Allows ORP mode to be used if CI measurement is a problem
29	Language	Allows choice of language
30	System Reset	Restarts controller - safer than turning off and on

9.3. Technician Menu

Table 20: Technician Menu

Menu #	Name	Description
51	CI P factor	Proportional Factor for CI Relay 1
52	CI pump period	1 Pump cycle (on +off time) for CI Relay 1
53	CI pump freq	CI pump max pulses/min, 0 for on/off pump
54	CI Overfeed Time	Will open relay 1+2 if CI feeding continuously for this time
55	CI Averaging	Displays an average of the last 4 CI readings
56	CI < 0.1 Alarm	If CI drops below this level, Alarm indicated and Opens CI Relay 1+2
57	pH p factor	Proportional Factor for pH Relay 3
58	pH pump period	1 Pump cycle (on +off time) for pH Relay 3
59	pH pump freq	pH pump max pulses/min, 0 for on/off pump
60	pH Overfeed Time	Will open relay 3 if pH feeding continuously for this time
61	pH balance type	To Select if Acid or Base is being added to adjust pH
62	Flow Sensor	Will turn display of Flow rate on/off (only use if flow meter connected)
63	Flow Rate	Choose between metric and US units
64	Celsius/Farh	Choose between metric and US units
65	Temp Hysteresis	Value in degrees, below set-point which will close Temp Relay 6
66	Turbidity	Turns Turbidity Module ON/OFF (optional module)

67	NTU wiper interval	Interval for Turbidity Module Wiper to clean glass (optional module)
68	Minutes	Current Time for Data Logger
69	Hour	Current Time for Data Logger
70	Day	Current Time for Data Logger
71	Month	Current Time for Data Logger
72	Year	Current Time for Data Logger
73	Recording Interval	Time interval between readings stored on the on-board data logger
74	Address	Controller ID - used with external communication
75	Software Version	Current software version
76	Operator Password	Change operator password
77	Technical Password	Change technician password

9.4. Alarms

Table 21: Alarms

Alarm #	Alarm	Description	Result
A1	No flow	Flow switch in flow cell is off	No chemical dosing
A2	Low flow	External flow meter below minimum flow	No chemical dosing
A3	Check CLRMTR connect.	Communication error between colorimeter and colorimeter board	no chlorine dosing – optional ORP emergency mode
A4	No reagents	Reagents are empty	No chlorine dosing - optional ORP emergency mode
A5	Stuck piston	Piston is not moving properly	No chlorine dosing - optional ORP emergency mode
A6	Unclean cell	Glass in colorimeter is dirty	No chlorine dosing - optional ORP emergency mode
A7	Replace light	LED in colorimeter is not working	No chlorine dosing - optional ORP emergency mode
A8	Low reagents	Reagents are below 20%	--
A9	Chlorine < 0.1	Chlorine unusually low	No chlorine dosing
A10	High ORP	ORP above high limit	No chlorine dosing

A11	Low chlorine	Cl below low limit	--
A12	High chlorine	Cl above high limit	--
A13	Low pH	pH below low limit	--
A14	High pH	pH above high limit	--
A15	Low ORP	ORP below low limit	--
A16	High NTU	Turbidity above high limit	--
A17	EXTERNAL OFF	External flow switch is off	No chemical dosing
A18	Total Cl high	Total Cl above high limit	--
A19	Combine Cl high	Combined Cl above high limit	--
A20	Replace DPD3	DPD3 low	Total Cl testing stops
A21	Temp. low alarm	Temperature below low limit	--
A22	Temp. high alarm	Temperature above high limit	--
A23	Cl overfeed time	Cl dosing on for longer than max time	Cl dosing stops until reset
A24	pH overfeed time	pH dosing on for longer than max time	pH dosing stops until reset
--	No Emergency	No problem to allow ORP emergency mode	--

10. Setting Proportional Control

10.1. Proportional Control Overview

The many variables that control pool chemical balance make each pool unique. These variables include:

- Pool size
- Capacity of dosing and filtration systems
- Type of chemical used
- Controller reaction time

The above variables affect two primary control characteristics:

- Delay time between chemical dosing and when the controller senses these chemicals.
- How strong a response a dose of chemicals produces in the controller.

Older pool water chemical controllers worked in basic on/off modes. The controller supplied chemicals at a constant rate until it sensed that it reached the chemical balance set point. This type of operation caused major fluctuations in water chemical levels, which wasted chemicals and caused chemical levels to cross the desired high and low thresholds.

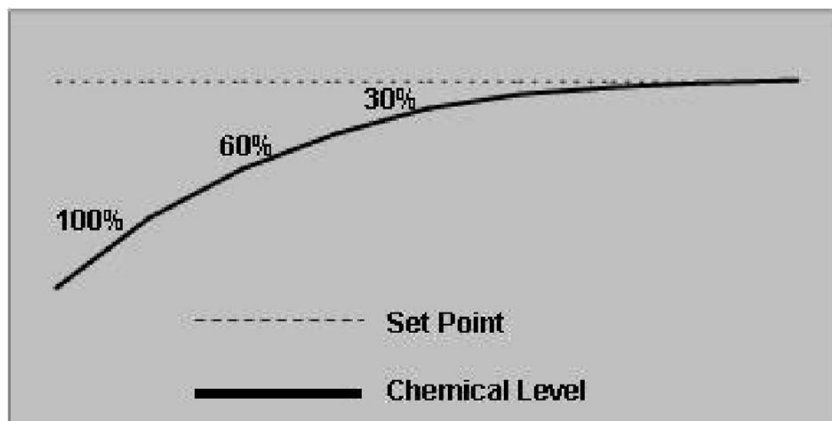


Figure 36: Chemical levels with ON/OFF Mode Controllers

HYDROGUARD controls dosing proportionally. This method sets dosing rates in relation to how far current chemical levels are from the set point. The dosing rates gradually decrease as chemical levels get closer to the set point.

If water chemical levels are far below the set point, HYDROGUARD will control the dosing systems to operate at full capacity (100%). As the controller senses chemical levels rising and getting closer to the set point, it will control the dosing systems to slow down to a lower capacity (60%). As chemical levels get even closer to the set point, the dosing system will slow down even more (30%), and so on, until the chemical level gets to the set point.

With proportional only control, it is difficult to reach the set-point in larger or more heavily used pools

because the dosing rate slows too early. Conversely, in small pools or spas the set-point may be exceeded because the dosing did not slow early enough. The P-factor allows the controller to be customized to the specific pool. The percentage of the time on is explained by the following equation with chlorine as an example:

$$\%time_{on} = \left[\frac{(\text{setpoint} - \text{measured})}{\text{setpoint}} \right] \bullet P_{\text{factor}}$$

In this example, the Cl set-point and measured values are:

Cl Set Point	Cl Measured
2.0	1.8

If the P-factor is changed, the percentage of the pump cycle that will be on (% time on) changes as follows:

Table 22: P-factor

P _{factor}	% Time ON
0.1	1%
0.5	5%
1	10%
5	50%
10	100%

The range for P-factor for Cl and pH are presented in the table below.

Table 23: P-factor Range

Cl p Factor	50	On/Off control
	0.1	Very proportional and slow dosing
pH p Factor	100	On/Off control
	0.1	Very proportional and slow dosing

10.2.Setting Proportional Factor

Proportional control of chemical dosing requires configuration according to various factors. The primary factors are the ratio between the pool size and the rate the chemical dosing systems can feed chemicals, and the delay time between when the chemical level changes and when it is sensed by the controller.

In large pools, changes in chemical levels occur slowly. The dosing systems must

feed large amounts of chemicals for a long period of time in order for a change to be noticed. The chemicals also disperse slowly in larger pools. Smaller pools, on the other hand, react much more quickly.

The length of time between the change and when the controller identifies the change also affects proportional control. The controller can only identify water chemical levels after they have been distributed throughout the pool, and have returned to the pump room for analysis by the automatic controller. This may be a long time after the chemicals were released into the pool. The controller, therefore, recognizes the chemical levels from dosing settings in the past. The dosing systems continue feeding chemicals during this delay, causing chemical levels to pass the set point, resulting in fluctuations.

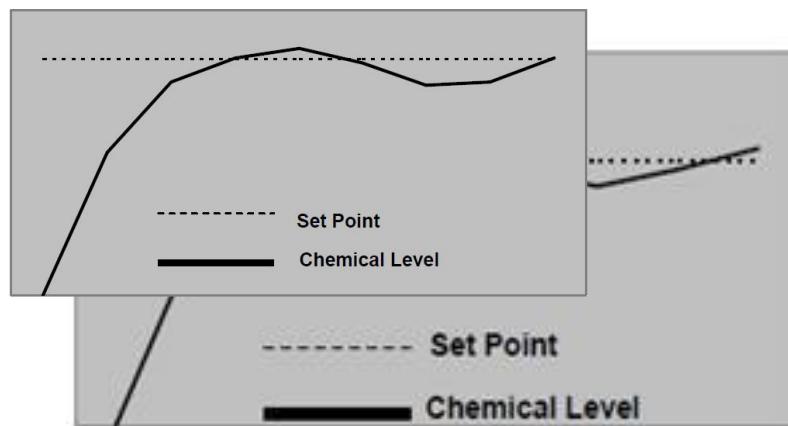


Figure 38: Feedback Delay Causes Chemical Levels to Pass the Set Point

To prevent these fluctuations, the controller must reduce chemical dosing rates as it senses that chemical levels are approaching the set point, taking the delay into account. The controller should also not overcompensate for the delay, which would cause chemical levels to not reach the set point at all.

The proportional factor for chlorine and pH proportional control can be set on a scale of zero point one (0.1) to fifty (50) for total chlorine and zero point one (0.1) to one-hundred (100) for pH. A high proportional factor means that chemical levels rise and fall unimpeded until they cross the set point, as displayed below.

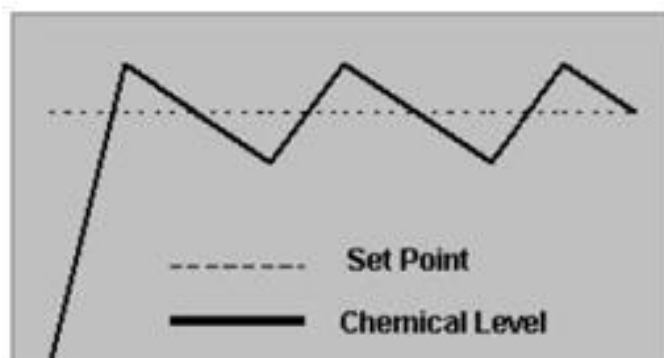


Figure 39: Proportional Factor = 50

A low proportional factor slows the chemical flow rate far from the set point and it will take a very long time for chemical levels to get near the set point.

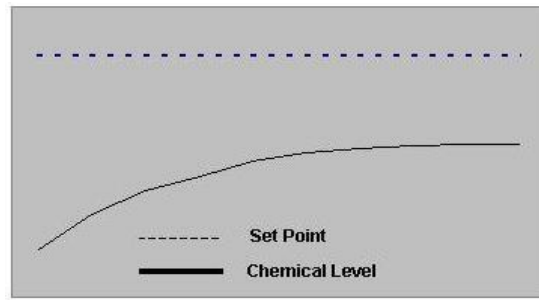


Figure 41: Proportional Factor Too High

The proportional factor must therefore be suited for the particular pool, with its specific conditions.

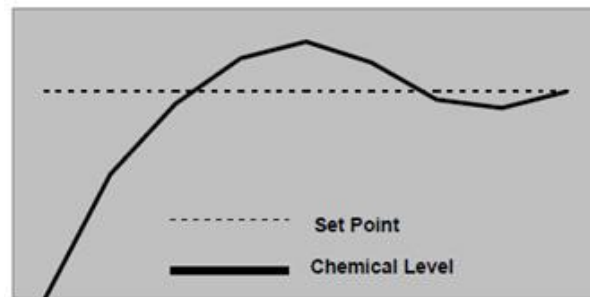


Figure 42: Proportional Factor Too Low

When setting the proportional factor in HYDROGUARD, start with the recommended settings according to the size of the pool. HYDROGUARD then learns how to correlate the fluctuations automatically. The fluctuations eventually get smaller and chemical levels remain close to the set point. Contact Blue I Customer Support and Training for more information on setting the proper proportional factor for your pool environment.

10.3.Setting Pump Period

Pump period is a single cycle during which the dosing pump operates and then rests. Proportional control divides the pump period into two distinct phases: active and at rest.

In general it is recommended to operate in a short cycle, i.e., 00:30 Sec. For large pools, or if you activate solenoid valves, you may consider longer pump periods.

10.4.Step By Step Proportional Settings

1. Finish the installation of all controllers (electrical, water, feeding systems, and electrodes).
2. Calibrate the controller to the water chemical values at the sample point.
3. Set the proportional factor and the pump period of the chlorine and the pH per the recommended setting in sections 7.5 and 7.6.

4. Let the controller operate the chlorinator and the pH correction devices and make sure that chemicals are injected into the water.
5. Watch the chlorine and pH as they change. We recommend that you record the values frequently so that the process is closely monitored.
6. If the values exceed the set point, you need to decrease the proportional factor.
7. If it takes too long to get to the set point, you need to increase the proportional factor.

Note: In large pools the delay time between injection of the chemicals and receiving the change in the controller can be very long (30 minutes or more).

For this reason the process of getting a good control loop, which can take 15 minutes in very small pools, can be very time consuming in large pools – up to a few hours.

Note: It is possible to set up initial parameters per the recommendations in sections 7.5 and 7.6 and download the information after 24 hours to a PC, making corrections according to the graph of the last 24 hours. In any case, after installation the technician should stay a sufficient amount of time to make sure that the control loop is within an acceptable range.

Recommended: In systems equipped with the Expert Pool GPRS communicator, this process can be performed remotely using BLUE I internet remote access.

10.5.First Time Chlorine Average Setting

Table 24: Chlorine Settings

Pool Volume (m ³) Thousand Gallons		Cl Proportional Factor	Cl Pump Period
1-5	4-20	0.1-3	0:30
6-10	20-40	3-6	0:30
11-50	40-200	5-7	0:30-1:00
51-100	200-400	6-9	1:00-1:30
101-200	400-800	7-13	1:30-2:00
201-500	800-2000	8-15	2:00-4:00
500+	2000+	12+	4:00

10.6.First Time pH Average Setting

Table 25: pH Settings

Pool Volume		pH Proportional Factor	pH Pump Period
(m ³)	Thousand Gallons		
1-5	4-20	0.1-5	0:30
6-10	20-40	4-10	0:30
11-50	40-200	6-20	0:30
51-100	200-400	10-30	0:30-1:00
101-200	400-800	14-40	1:00-1:30
201-500	800-2000	16-50	1:30-3:00
500+	2000+	18-70	3:00-4:00

11. Record Values Setting

Before leaving the site, perform the procedure in this section and record the requested values.

Calibrate the following HYDROGUARD parameters and enter the information into the table below.

Table 26: Record Values Setting

Date	Site	Technician's Name
Parameter	Controller Reading	External Device Reading
Free Chlorine		
Total Chlorine		
pH		
Redox		
Temperature		

12. Technical specifications

MECHANICAL DATA		pH MEASUREMENT*	
Dimensions (controller) (W x H x D)	670 x 330 x 130mm (26.4" x 13" x 5.1")	Measurement Range	4 to 10
Dimensions (mounting board)	800 x 550 x 5 mm (31.5" x 21.7" x 0.2")	Sensor	Ceramic diaphragm and gel filling
Cable entries	Pg 9 Cable Glands	Input impedance	0.5 . 10 ¹² Ω
Max. ambient temperature	2°C to 55°C (35.6°F to 131°F)	ORP (REDOX) MEASUREMENT*	
Weight approx.	11 kg (24 lbs)	Measurement range	0 to 1000mv
ELECTRICAL CONNECTION		Sensor	Ceramic diaphragm and gel filling
Power supply	100-115 VAC/1A; 200-230 VAC/0.5A; 50Hz/60Hz	TEMPERATURE MEASUREMENT*	
Power consumption	Approx. 60 VA	Sensor	PT-100
Power supply for RTC	3.6V lithium battery	Measuring range	0°C to 50°C (32°F to 122°F)
DATA SERIAL OUTPUT / SIGNAL OUTPUT		MEASURING CELL	
RS 485	Standard half-duplex	Working temperature	1°C to 45°C (33.8°F to 113°F)
4-20mA	optional	FLOW REQUIREMENTS	
RELAYS		Measuring cell flow rate	35L/h - 60l/h
Chlorine set point 1	250VAC/DC 4A Max	Inlet pressure	0.3 bar (4.4 psi) to 1 bar (14.5 psi)
Chlorine set point 2	250VAC/DC 4A Max	Outlet pressure closed cell	Up to 0.9 bar (13 psi)
pH	250VAC/DC Max	Flow switch type	Rotary switch
Turbidity control*	250VAC/DC 4A Max	FLOW MEASUREMENT	
General alarm	250VAC/DC 4A Max	Frequency input or 4-20mA input	via I/O card via NTU card
Temperature control	250VAC/DC 4A Max	Measurement range	0-1,000 m3/hour
DISPLAY		PRESSURE REQUIREMENTS	
Measured value displays	Chlorine, pH, ORP, Temperature, Flow*, Total Chlorine*, Turbidity*, Conductivity	Inlet Pressure	0.3 bar (4.4 psi) to 1 bar (14.5 psi)
Function indicator	Auto, off/on mode for chlorine pH and dosing indication by Red and Green LEDs	Outlet pressure close cell	Up to 0.9 bar (13 psi)
2 line 24 character LCD with background light For secondary parameters, program alarms and status		Outlet pressure open cell	Gravity
2 x 7 segment red display 3 digits For chlorine and pH		pH VALUE CONTROL	
CHLORINE MEASUREMENT		Control function	Proportional or On/Off
Measurement	Free and/or Total chlorine	Characteristics	Normal / Inverted
Sensor	Colorimetric multi-spectrum sensor	Relay function	Pulse length proportional controller Pulse frequency proportional controller
Cell cleaning	Automatic self-cleaning mechanism (patent)	CHLORINE CONTROL #1	
Mixing technology	Inner solenoid activated active mixer (patent)	Control function	Proportional or On/Off
Measurement range	0 to 10ppm	Proportional band	Yes
Measuring Interval	2 to 10 minutes using the adaptive measurement™ method	Relay function	Pulse length proportional controller Pulse frequency proportional controller
Max. inlet operating pressure	1 bar (14.5 psi)	CHLORINE CONTROL #2	
Flow rate colorimetric cell	3 to 12 LPH @ 1bar (0.75 to 36 GPH @ 14.5 psi)	Control function	On/Off
Working temperature	1°C to 45°C (33.8°F to 113°F)	Proportional band	No
REAGENTS		Integral action time	No
Reagent type	DPD1, DPD3, DPD4	DATA LOGGER	
Reagent consumption	Min ~0.033 ml per sample	Memory	256 Kbit
Shelf life	Unmixed DPD1 & DPD4 3 years, DPD3 15 months Mixed: Recommended 60 days	Lines	1000
		Recording interval	1-360 min
		Event logger	Yes
		Total relay on time	Yes
		SECURITY	
		Operation password	Yes
		Technician password	Yes
		*Optional Feature	

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Patents issued and pending at the time of this printing

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